TABLE OF CONTENTS

1 FOREWORD

CHAPTER 1

4 An Ecosystem Under Stress

7 History

9 Human Impacts on the Natural Environment

16 Liverpool

18 The Regulatory Environment

CHAPTER 2

20 A Vision for the Future

20 The RAP Goals

Where We are Going

24 The RAP Goals

How to Reach Them

CHAPTER 3

26 Strategies for Cleaning up the RAP Area

28 The RAP Principles

30 Options for Remediation

34 Testing Options Against the Principles

38 Conclusion

CHAPTER 4

39 The Next Steps

39 Ongoing Remedial Actions

41 The RAP Process

42 How You Can Get Involved

44 GLOSSARY

46 APPENDIX A

Participants

48 APPENDIX B

The Commitment

50

Remedial Actions

Remedial Action Plan
Plan d'Assainissement

ISBN 0-7729-9001-3

92-04502/

This report is about the waters in the Metro Toronto area. It aims to tell how the waterfront and watersheds in Canada's largest and most prosperous city became polluted. It also tells the story of how those waters can be restored to health. It is a story which tries to involve you - the reader - in the process of restoration, one which tries to change you from being a passive observer to an active participant. It is a tale of how people like you, while being part of the problem, can also become part of the solution, if you so choose.

The recent history of the waters in the Metro Toronto area begins with the International Joint Commission, (the IJC).

The IJC was founded in 1909, and is responsible for preventing and resolving issues affecting the boundary waters between Canada and the US. In 1985, after many years of collecting and publishing information on pollution in the Great Lakes, in response to public pressure for action, the IJC released a list of 42 Great Lakes sites where it was felt that water pollution was a significant problem.(In 1990, a 43rd area - Erie Harbor, Pennsylvania - was added to the list.) These sites (or "Areas of Concern") included 17 sites in Ontario, one of which was the Metro Toronto Waterfront. Upon issuing its list, the IJC asked governments on both sides of the border to develop Remedial Action Plans in each of these areas to clean up and restore the waters. Each of these Areas of Concern is unique, with its own set of problems relating to local sources of pollution, geography, and other factors. In each of the Areas of Concern, the IJC has identified the "beneficial uses" which need to be restored. Beneficial uses include the use of water by humans for drinking, swimming, fishing, shipping or industrial purposes, and the use of water by birds, fish and other wildlife.

Remedial Action Plans (RAPs) can be thought of as comprehensive blueprints for restoring beneficial uses by cleaning up polluted areas. They are deveioped in three stages.

LAKE SUPERIOR
1. Peninsula Harbour
2. Jackfish Bay
3. Nipigon Bay
4. Thunder Bay
5. St. Louis River
6. Torch Lake
7. Deer Lake

LAKE MICHIGAN
8. Manistique River
9. Menominee River
10. Fox River/Green Bay
11. Sheboygan Harbor
12. Milwaukee Harbor
13. Waukegan Harbor
14. Grand Calumet River
15. Kalamazoo River
16. Muskegon Lake
17. White Lake

LAKE HURON
18. Saginaw River
19. Collingwood Harbour
20. Severn Sound
21. Spanish River

LAKE ERIE
22. Clinton River
23. Rouge River
24. River Raisin
25. Maumee River
26. Black River
27. Cuyahoga River
28. Ashtabula River
29. Erie Harbor
30. Wheatley Harbour
31. Buffalo River

LAKE ONTARIO
32. Eighteen Mile Creek
33. Rochester Embayment
34. Oswego River
35. Bay of Quinte
36. Port Hope
37. Metro Toronto and Region
38. Hamilton Harbour

CONNECTING CHANNELS
39. St. Marys River
40. St. Clair River
41. Detroit River
42. Niagara River
43. St. Lawrence River

Figure 1: Forty-three areas around the Great Lakes have been identified as "Areas of Concern"

Stage 1 of a RAP begins with the definition of the problems in an area, and the identification of the causes of the problems.

In Stage 2, goals are set, and identification begins of remedial options (those actions which can potentially solve or help to solve the particular problems of an area). Because there is often more than one solution to a particular problem, it is necessary to weigh the advantages and disadvantages of all options before selecting the "best" ones. When these are selected and the list of remedial options is finalized for an area, then a schedule for implementation is developed and agents are identified to carry out the actions. At the end of Stage 2, the final Remedial Action Plan is produced. The Plan includes a program of monitoring in order to measure progress as the cleanup proceeds.

Stage 3 of a RAP is the implementation stage which lasts until the monitoring program demonstrates that the problems have been solved. When that occurs for each of the Areas of Concern, the area waters will have been restored to health.

In Canada, RAPs are spearheaded by the federal and provincial governments, through Environment Canada and the Ontario Ministry of the Environment (MOE). In Metro Toronto and Region, a number of groups are involved in the development of the Remedial Action Plan. As illustrated in Figure 2, a RAP Team acts as a steering committee for the process. It is made up of senior representatives from Environment Canada, the MOE, the Ontario Ministry of Natural Resources, the Metro Toronto and Region Conservation Authority, Metro Toronto, and the municipalities of Toronto, Scarborough and Etobicoke.

Advice on the feasibility of remedial options and other technical matters is provided by a Technical Advisory

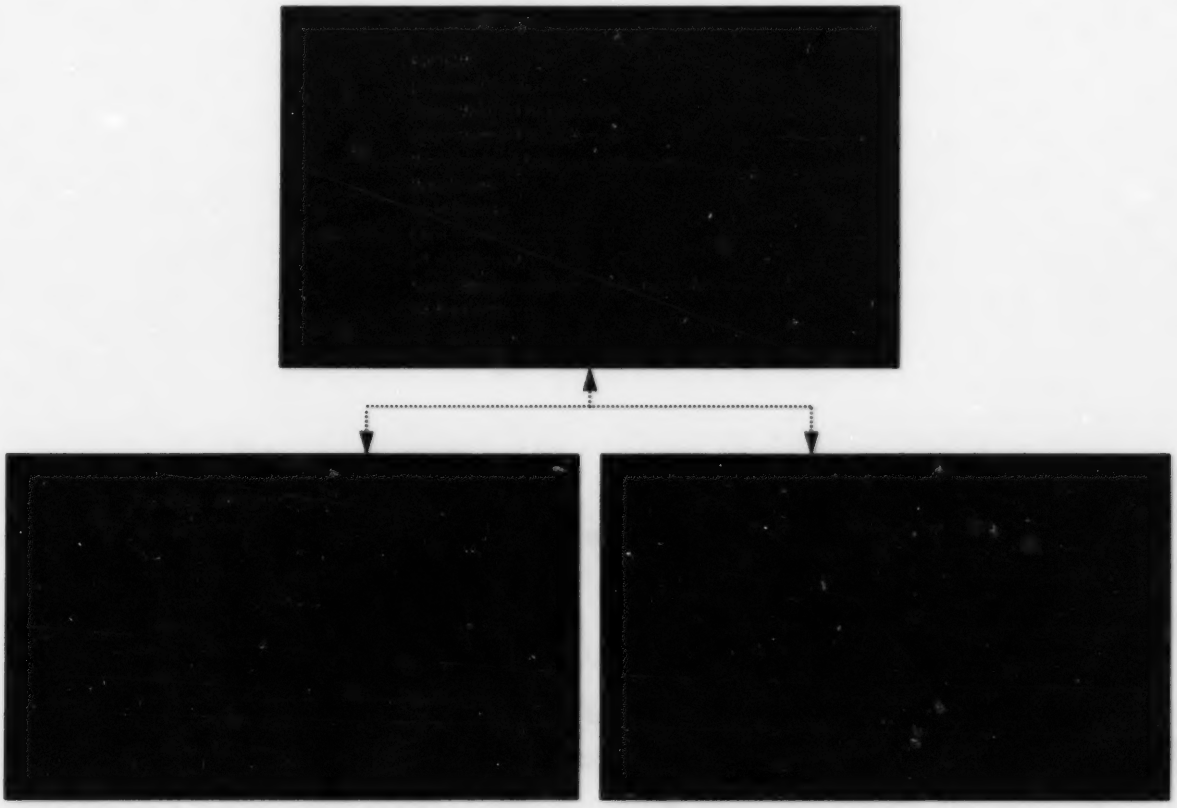

Figure 2: Committee Structure of the Metro Toronto and Region Remedial Action Plan

Committee. A Scientific Advisory Committee identifies information gaps and recommends appropriate research to support remediation efforts.

A Public Advisory Committee has been set up with a broad representation from a wide variety of sectors including environmental groups, industry, tourism, municipalities, agriculture, labour, recreation, community groups and individuals. The Public Advisory Committee plays a vital role by providing ongoing input as the RAP is developed, and by disseminating information to member groups in each sector.

The Metro Toronto and Region RAP is currently in Stage 2 of its development. A number of milestones have been passed to date:

- The Stage 1 RAP document, *Environmental Conditions and Problems*, was released in September 1988. This document outlined the environmental problems along the Metro Toronto Waterfront and identified the major sources of the problems.

- After a consultative process, in the summer of 1989, the Public Advisory Committee released its set of goals for the RAP - goals which reflect the public desire to restore and protect water quality in the watersheds and waterfront in the Metro Toronto area.

- In April 1990, the *Draft Discussion Paper on Remedial Options* was released and subsequently reviewed by the Technical and Public Advisory Committees. This is a technical document which provides detailed information on the possible remedial options which could be used as part of the Metro Toronto and Region RAP.

- To guide the RAP process and to help in evaluating options, in May 1991, a set of 16 RAP Principles was developed jointly by the Public, Technical and Scientific Advisory Committees, and the RAP Team.

The task now facing the RAP Team and its Advisory Committees is to select which options should become part of the final Plan. And that brings us to this report.

Strategies has two objectives. The first is to inform people generally about the problems facing the waterfront and watersheds, to let people know about the Metro Toronto and Region RAP process, and what has been accomplished to date. The second goal is to report on (and receive feedback on) the way in which remedial options will be selected - or the strategy to be employed to select options. Providing this feedback is one important way in which you can help to restore our waters.

Chapter One of this report provides the reader with an overview of the environmental problems facing the waterfront and watersheds in the RAP area. Chapter Two reviews the goals which have been set by the Public Advisory Committee. Chapter Three introduces the RAP Principles and describes how using them would affect the kinds of options selected. Chapter Four describes the next steps in the RAP planning process, and outlines how members of the public can become involved in helping to clean up the waterfront and the watersheds in the RAP area.

Those of us involved in the Metro Toronto and Region RAP feel that we have a unique opportunity to achieve a healthy waterfront. Where the casual observer sees today a diminished, degraded Don or Humber River, we see in the future clean rivers able to support spawning sport fish. Where today we have beaches closed every summer because of high bacterial counts, we can envision sparkling clean Lake Ontario waters in which swimmers and windsurfers play without fear of disease. We can see thriving wildlife communities and fish which can be eaten by anglers with no fear of ill effects - in short, a healthy, balanced and sustainable ecosystem for humans and wildlife.

Fulfilling this vision will not be easy, but we believe that restoring our waters can - indeed must - be done. With your support, we can meet this challenge.

The area originally designated for cleanup in Metro Toronto was the waterfront between Etobicoke Creek in the west and the Rouge River in the east. It would be futile, however, (if not impossible), to attempt to clean up the waterfront without also cleaning up the rivers which flow into it. Accordingly, the Metro Toronto and Region Remedial Action Plan (RAP) is aimed at restoring water quality in the six watersheds which drain into the waterfront and along the waterfront itself.

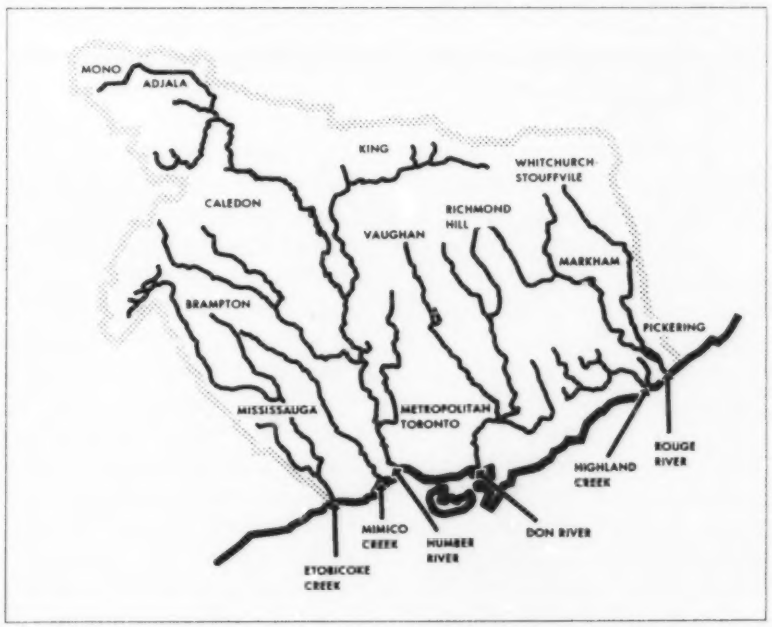

Figure 3: The Metro Toronto and Region RAP Area

From west to east these watersheds include the Etobicoke and Mimico Creeks, the Humber River, the Don River, Highland Creek and the Rouge River. In total, the drainage basins of these six watersheds encompass about 2,000 km^2. The headwaters of the Don, Humber and Rouge Rivers lie to the north in the rolling hills of the Oak Ridges Moraine. A portion of the Niagara Escarpment cuts through the northwest corner of the RAP area.

In terms of the political landscape, the Metro RAP area includes five regional governments - Metropolitan Toronto, Dufferin County, and the Regions of Peel, York and Durham - and 17 municipalities. These are Etobicoke, North York, York, Toronto, East York, Scarborough, Mississauga, Brampton, Caledon, Mono, Adjala, King, Richmond Hill, Vaughan, Markham, Whitchurch-Stouffville and Pickering.

HISTORY

The natural landscape in the Metro RAP area was, in large part, shaped by the retreat of the Wisconsin glaciers during the last ice age, some 15,000 years ago. As they retreated, the glaciers carved out the rivers, creeks and lakes in the area, and deposited the fertile soils which characterize it.

Also left behind in the glaciers' wake was the Oak Ridges Moraine, a complex, hilly area of sand and gravel deposits. Rainwater filters downwards in the Moraine, moves laterally and then discharges upwards to form the headwaters of virtually all the rivers flowing north and south in the area. The Moraine is a drainage divide - rivers in the northern part drain into Lake Simcoe, those in the south empty into Lake Ontario.

At the mouths of the rivers flowing into Lake Ontario, fertile marshes were formed after the ice age ended and temperatures rose. Records and archaeological findings tell of habitation in the area by the Hurons, the Iroquois, and later the Mississaugas. Early French fur traders noted the native presence along the Humber River - the so-called Toronto Carrying Place - which lay on the fur trade route linking Lake Simcoe and the north to Lake Ontario.

When European settlers first arrived in Toronto (then newly-christened York), 200 years ago, they found a rich and varied region of rivers and forests. The natural harbour was a major attraction to people concerned about the emerging military might of the Americans to the south. Because of the presence of the peninsula (which was later to become the Island), Toronto's harbour provided one of the few naturally protected areas on the north shore of the lake. In a country where travel by land was largely impossible, a safe harbour was an absolute necessity for communications, travel and trade, and almost a prescription for settlement.

Two hundred years ago, the rivers, the harbour and the lake teemed with aquatic life - sturgeon, lake herring and dozens of other species. The Indians speared Atlantic salmon in the Harbour, and anglers and market gunners captured fish, turtles and waterfowl in the Humber and Ashbridge's marshes for the tables of the new citizens of York.

Clearing of the forests for housing and farmland began on the shores of Lake Ontario and moved inexorably northward, destroying wildlife habitat and displacing large mammals such as wolves and deer. Rivers were dammed to generate power for saw and grist mills, and later straightened and encased in concrete to better control their unpredictable nature.

As the population of York grew and transportation by land became more viable, large portions of the waterfront were filled in to provide space for rail lines, shipping facilities, and industrial lands. In the central waterfront, virtually all the land south of Front Street was created by lakefilling, as was much of the land in the Western Beaches. In the early part of the twentieth century, the Port Industrial Area at the east end of the harbour was created by filling in the Ashbridge's marsh at the mouth of the Don River. The Leslie Street Spit was begun in 1959 to provide space for expanded harbour facilities which have not been needed. More recently, a series of waterfront parks jutting out into Lake Ontario have been created by lake-filling. These include Humber Bay Park, Ontario Place, Ashbridge's Bay Park and Bluffer's Park.

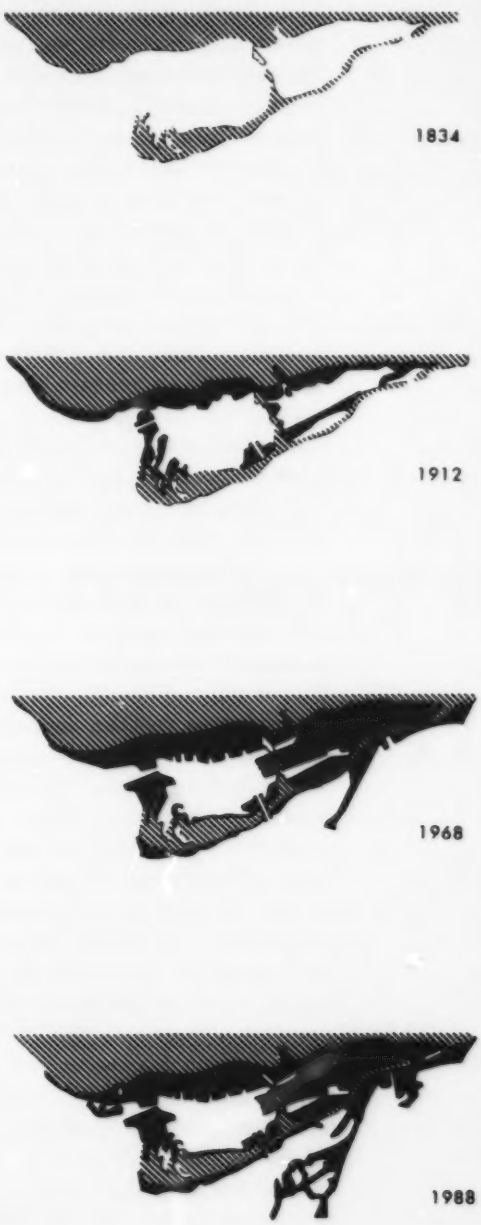

Figure 4: The changing shape of Toronto's Waterfront

In the early 1930s, Toronto was quite small - virtually ending at Eglinton Avenue in the north - and surrounded by rural land stretching up to Lake Simcoe. After World War II, however, development pressures became greater and greater as the population boomed. The Metropolitan Toronto of 1991 is almost totally urbanized within its boundaries, and suburban development surges northward into York Region. Indeed, a band of almost complete urbanization runs along the lakeshore from Hamilton in the west to Oshawa in the east.

The RAP area is home to about 2.5 million people, and is located within the Greater Toronto Area. (The Greater Toronto Area, or GTA, includes the regions of Durham, Halton, Metro, Peel and York). The GTA is densely populated - with about one percent of Ontario's land, it hosts about 40 percent of the province's population. As the country's economic heartland, the GTA is the manufacturing capital of Canada, and provides a great many jobs in finance, trade, commerce and other sectors. To a large degree however, the development of this economic heartland has been accomplished at the expense of the natural environment.

In large part this has occurred, not intentionally, but because of a lack of understanding of ecological processes. Two hundred years ago, the actions of people in the area were framed by the belief that Lake Ontario - that large body of water to the south - was big enough to infinitely accept the pollutants dumped in it. The realization that this might not be true started in the latter half of the last century, by which time the untreated sewage from Toronto and animal wastes had turned Ashbridge's Bay into a pestilential swamp. The subsequent rise of the public health movement, and the building of sewage treatment plants, (Toronto's first one was built in 1910), caused dramatic improvements in the health of both Torontonians, and of the nearshore waters of Lake Ontario. As our understanding of our environment has grown, so has our understanding of how our day-to-day activities affect it.

Today, we know that the Metro Toronto and Region RAP area is under many kinds of stress. In terms of human activities affecting the natural environment, these stresses include **physical restructuring** - dredging of waterbodies, altering of shorelines, damming and channelization of rivers, and draining of wetlands. A second category of stresses includes the **removal of natural resources** including surface and groundwater, minerals, fish and forests. A third kind of stress is the **addition of nutrients and toxic contaminants** into the environment, contaminants which end up in the area's air, water, soil, plants and animal tissues. A fourth kind of stress is that caused by the **introduction of foreign species** of plants and animals. All these factors have contributed to an ecosystem which is under stress, one which requires clean up in order to restore balance and equilibrium.

The next section looks at the Metro Toronto and Region RAP area and outlines the impacts which human activities have made on the waterfront and watersheds.

HUMAN IMPACTS ON THE NATURAL ENVIRONMENT

Physical Restructuring

It has been estimated that 70 to 80 per cent of the wetlands which once existed in southern Ontario have been altered or destroyed. This is because, as a society, until relatively recently we were generally unaware of their importance in natural systems. Wetlands were viewed as nuisances and often as health hazards. And so they were drained or filled in for farmland, paved over for housing or lakefilled to provide space for industry or transportation. We now know that wetlands are vital environments at the interface where land and water meet, and that they provide a rich and varied habitat for invertebrates, fish, reptiles and amphibians, mammals and birds. Wetlands also play an important role in filtering out contaminants in water. In the Metro Toronto and Region RAP area, significant marshes remain along the waterfront at the mouths of the Humber and Rouge Rivers. Many smaller wetlands remain scattered across the Oak Ridges Moraine.

We have already mentioned the extensive alterations which have been made to the shorelines through lakefilling in the Metro RAP area. It is not just the structures which are built that are important, but also how they are built. The north and east shores of the Inner Harbour, for example, are "hard-edged," vertical walls which were built to allow freighters to dock. The creation of such hard-edged shorelines destroys the natural shallows at the water's edge which are vital for fish spawning and feeding. Other lakefill projects, such as Ashbridge's Bay Park, with its soft edges and embayments, provide useable habitat for aquatic life. Even when done with the best of intentions, however, lakefilling can have adverse effects on the natural environment. Existing habitats are lost and the composition of fish communities change. Currents can be altered, changing the patterns of erosion and deposition of sand, and local water quality can be adversely affected during construction.

Extensive physical alterations have also been made to the creeks and rivers in the RAP area. With the exception of the Rouge River which remains in a fairly natural state, the lower reaches and tributaries of the other creeks and rivers in the Metro RAP area have been physically altered. The Don is a good example - the natural meanders in its lower reaches have been straightened and encased in concrete channels, thereby losing much potential for habitat. These concrete walls were built to reduce erosion during rain storms; today different materials are used which both reduce erosion and provide usable habitat.

Perhaps more important still, in terms of the health of the rivers in the area, is the loss of feeder streams. A healthy river is, by analogy, similar to a healthy tree. A tree has a large trunk which divides into two main branches, which then divide again and again to form smaller and smaller branches. Cutting too many of its small branches can harm a tree. The physical structure of a river is like the tree, and removing too many of its small branches can harm the river. The rivers in the RAP area, especially the Don, have lost many "feeder" streams over the last 200 years. Sometimes these have been paved over, sometimes buried underground in pipes. Figure 5 shows the feeder streams which have been lost in the Toronto area.

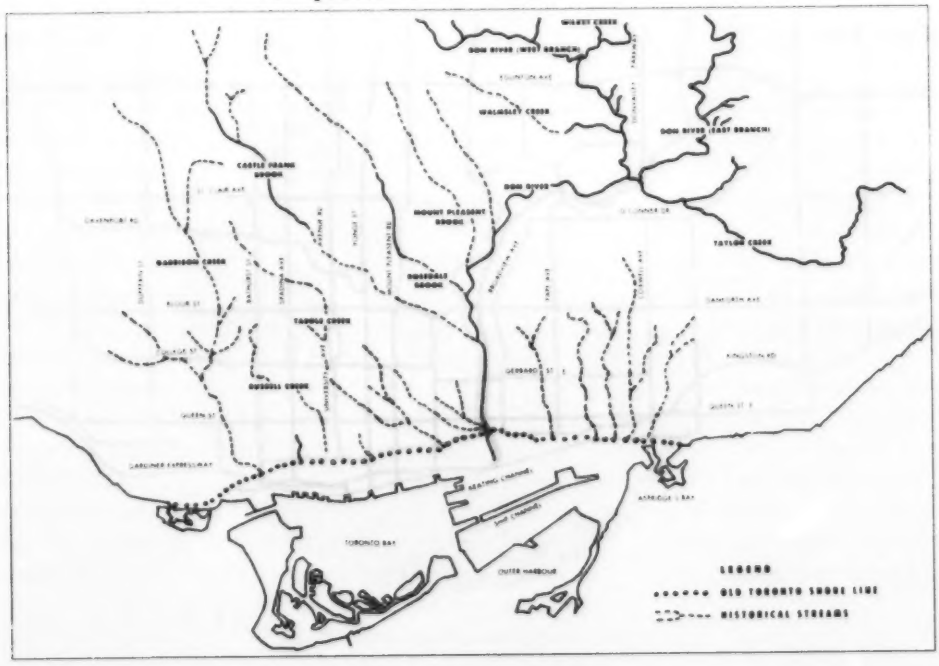

Figure 5: The Lost Streams of Toronto

The dams originally built by settlers to provide power for grist and sawmills have long since vanished. More recently though, in the wake of Hurricane Hazel, a network of dams was constructed to control flooding. Each of the rivers in the RAP area has at least one major dam, and hundreds of smaller weirs also dot the landscape. While providing a useful function in terms of reducing flooding and erosion, these structures prevent the seasonal migrations of spawning fish.

The physical restructuring of the landscape, (along with overfishing, the urbanization of the watersheds and the introduction of foreign species - see below), has greatly affected the fishery in the Metro RAP area. The Inner Harbour no longer provides suitable habitat for at least 20 of the 50 species originally found there, including muskellunge, walleye, sturgeon, whitefish, lake trout, Atlantic salmon and herring.

While there are parts of the waterfront which are significantly degraded for fish - the Keating and Ship Channels, for example - some fairly good habitat remains. In particular the Rouge and Humber marshes host varied communities of fish, as do some of the embayments in lakefill parks and on the Leslie Street Spit. The sheltered lagoons of the Toronto Islands provide the best habitat along the waterfront. In the water sheds, too, there remain some good quality habitat. The cold headwaters of the Humber and Rouge, for example, still support native brook trout.

Within the last decade, some gains have been made in the protection and rehabilitation of fish habitat in the RAP area. Some new habitat has also been created in recent years, (sometimes inadvertently, as at the Leslie Street Spit). These gains, together with improved pollution control at sewage treatment plants, control of fish harvest and fish stocking programs provide a base on which to build a strategy of improving the fishery in the Metro RAP area.

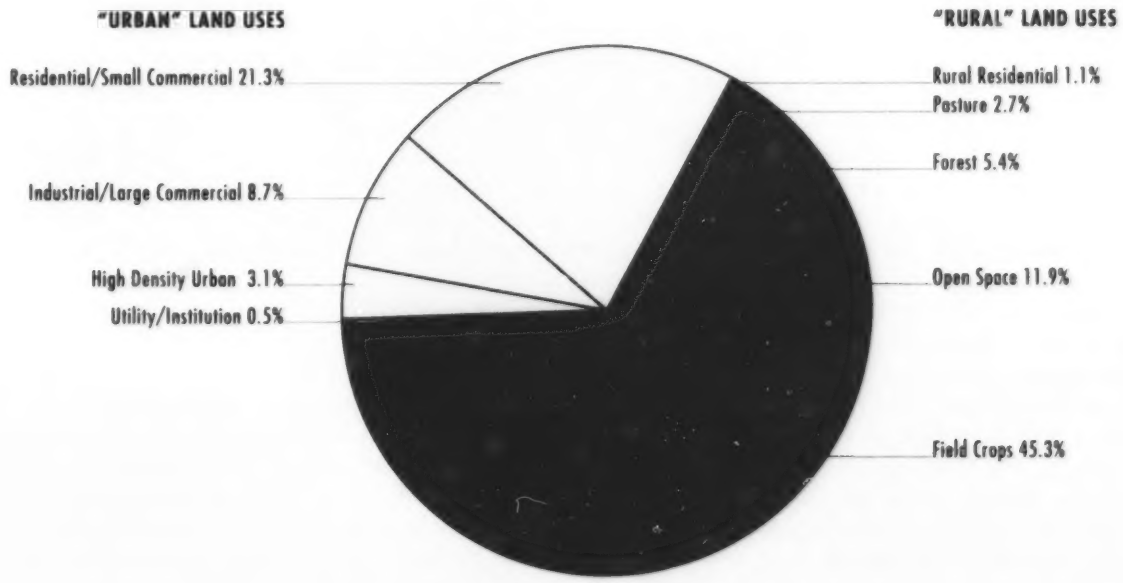

Figure 6: Land Use in the Metro Toronto and Region RAP Area

Removal of Natural Resources

In terms of the use of natural resources in the RAP area, the most important issues historically and for the future are the loss of forests, the loss of agricultural land and the overuse of groundwater. Other uses of natural resources which have had an impact on the environment include overfishing in the 19th century, and the removal of aggregates (sand and gravel).

The deforestation of the Metro RAP area began with the arrival of European settlers. Where once this was done for lumber or to clear the land for farmland, today it is more likely caused by creeping urbanization. Of the 2000 km^2 of land in the area, today only 5.4 percent (or 108 km^2) is forested. Forests provide habitat for wildlife, and have a beneficial effect on local climate and air quality. The cutting down of forests results in increased erosion and silting of nearby waterbodies.

Almost half - about 48 percent - of the Metro RAP area remains as agricultural land for pasture and field crops. For the most part this is found in the north. If one clusters together agricultural land, rural land which is used for residences, forest and open space, this "rural" category makes up two-thirds of the RAP area, the remaining one-third being urban in nature (see Figure 6). The relative proportion of rural to urban differs in the six watersheds in the area, however. About 90 percent of the Rouge watershed could be classified as rural. In contrast, the Highland Creek watershed is about 80 percent urbanized and the Don about 60 percent.

When agricultural land is removed from farm use and developed for housing, top soil is typically stripped off before building starts. This topsoil and vegetation stripping leaves little or no protection from erosive water which washes off soil into nearby creeks and rivers. The change in land use from rural to urban where a large proportion of the surfaces - streets, roofs and parking lots - are impervious to rain, dramatically increases the problems of stormwater runoff.

Groundwater is an important resource for many people living in the RAP area in northern Peel Region, parts of Durham and York Regions and Dufferin County. Some municipalities in these areas draw their water from groundwater which has been stored in deep underground aquifers for thousands of years. In some rapidly-growing areas, it is feared that this groundwater is being used faster than it can be replenished by water from the Oak Ridges Moraine. Some communities in these areas have initiated water conservation programs to address this problem.

Additions of Nutrients and Toxic Contaminants

The sources which add nutrients and toxic contaminants to the aquatic environment can be divided into three categories:

1. Significant impacts come from individual, relatively easy to trace sources which are often referred to as "**point sources**." These include: homes, industries, commercial establishments and institutions.

2. Significant impacts also come from "**non-point sources**." These are less easily defined (and therefore less easily controlled) discharges of stormwater which carry pollutants from both rural and urban areas.

3. **Other sources** of nutrients and toxic contaminants include fallout from the air, often referred to as "atmospheric deposition" and pollution from upstream sources in the Great Lakes, especially the Niagara River. They also include faeces from waterfowl, polluted bottom sediments, contaminated groundwater and soil, landfill sites and shipping and boating.

Point Sources:

In an urban setting, in homes, businesses or institutions, water is used for many purposes - for bathing, watering lawns, cooking, in industrial processes, as cooling water for machinery, etc. Most of the water used by urban dwellers is first taken from the lake and treated by the municipality, transported great distances to be used by people, poured down drains, and transported an equally great distance to be treated a second time by the municipality before being discharged to a river or lake.

People living in areas without municipal water and sewage treatment are usually aware of the limitations of wells, the need to maintain septic systems and the value of clean water. Many of us in urban areas, unfortunately, have lost sight of the "water cycle" - we just know that clean water comes out of the tap, and dirty water goes down the sink. We have forgotten that the water we pour down the drain today is the water we'll drink tomorrow.

Water treatment plants in the Metro Toronto and Region RAP area can pump and treat as much as 2,100 million litres (555 million gallons of water) a day from Lake Ontario. Kilometres of pipes distribute this treated water to the service population of approximately 2.2 million people. Another maze of sanitary sewers (about 5,000 kilometres of piping) transport the dirty water to sewage treatment plants. Daily these plants can treat 1,240 million litres (328 million gallons) of water before discharging to the rivers or Lake Ontario.

In between, this water gets used. In the City of Toronto, each resident uses on average 420 litres (or 92 gallons) a day. Human wastes are flushed down the toilets of homes, businesses and institutions, at 19 litres (or five gallons) of water a flush. In homes, people pour detergents down the drain, and sometimes small quantities of solvents, paints and other toxic products. Many of the small industries in the RAP area dump small quantities of heavy metals and toxic organic chemicals down the drain. No one knows exactly how many because it's difficult to trace.

This "river" of sewage, mixed with phosphates from detergent and low concentrations of toxic

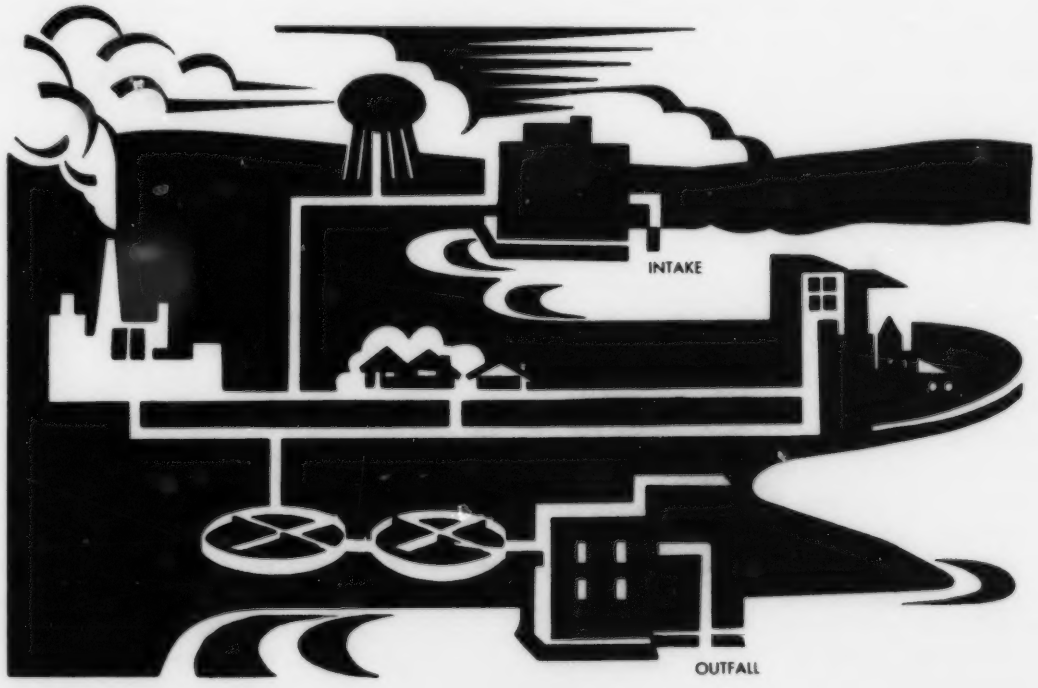

Figure 7: Water Use in an Urban Area

pollutants, is sent to the five sewage treatment plants in the Metro RAP area. Sewage treatment plants, however, are designed to treat human wastes and phosphorus from detergents, not chemicals and metals. And so a significant portion of these toxic contaminants pass through the treatment plants, ending up in the water or in bottom sediments near the outflow pipes of the plants. The portion of the toxic contaminants which is captured by the treatment plants ends up in the sewage sludge which is then incinerated. (The sludge is incinerated because the levels of contaminants make it unfit for spreading on agricultural land as fertilizer.)

Modern cities are built with two separate sewer systems - one for human wastes (sanitary sewage) and one for rainfall (stormwater). Older parts of Metro Toronto, like other cities in Canada, were built with a single system to handle both sewage and stormwater - so-called "combined sewers."

Although millions of dollars have been spent over decades to separate these combined sewers, portions of the old sewer system remain in some parts of Toronto, East York, Scarborough and York. When rain falls, stormwater mixes with untreated human sewage in combined sewers. During a heavy rain, the amount of combined sewage may exceed the capacity of pipes and the sewage treatment plants. If this happens, "combined sewer

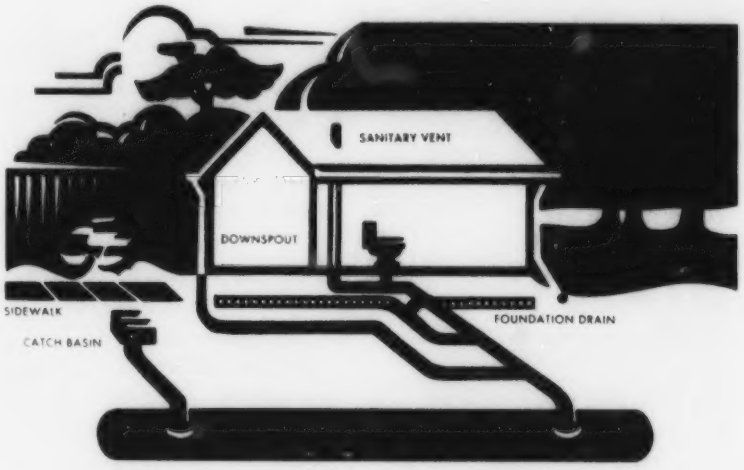

Figure 8a: A Combined Sewer System

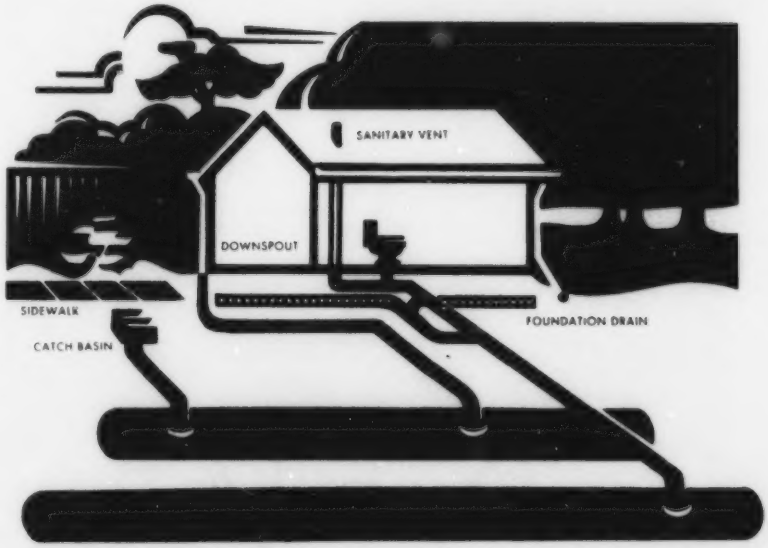

Figure 8b: A Separate Sewer System

overflows" occur and dilute untreated sewage rushes into the Humber and Don Rivers and directly into Lake Ontario. These combined sewer overflows can be thought of as "leaks" in the sytem. Overflows are discharged through 34 outfalls along the waterfront, and another 35 along the Don and the Humber (see figure 9).

Combined sewer overflows contain high concentrations of bacteria, nutrients and heavy metals. They play a major role in forcing the closing of beaches in the summer due to high bacterial counts. In Metro, beach closures happen routinely every summer. The cleanest beaches (in terms of number of days they are closed each summer) are those at Cherry Beach and Hanlan's Point which are the farthest removed from the impacts of combined sewer overflows.

Less obvious than the closing of beaches, but more important over the long term, is what happens to the heavy metals and organic chemicals which are dumped into the sewage treatment system by households and industries. Toronto's sewage treatment plants are the greatest sources of mercury, cadmium and copper to the waterfront. Provincial water quality guidelines for such parameters can be exceeded in the vicinity of these sewage treatment plants. Guidelines can also be exceeded at the mouths of the Don and Humber because of combined sewer overflows and stormwater. Once in the water, these pollutants can cycle into other compartments of the environment - into air, sediment and animal tissues. This is covered in the next section (**Linkages**).

Excess nutrients can have a significant effect on aquatic systems. High levels of phosphorus, for example, can cause aquatic plants such as algae to grow at an explosive rate. High levels of phosphorus are found everywhere along the waterfront in the Metro RAP area due to combined sewer overflows and discharges from sewage treatment plants. The levels of phosphorous are high enough that one might expect significant growth of algae. Somewhat

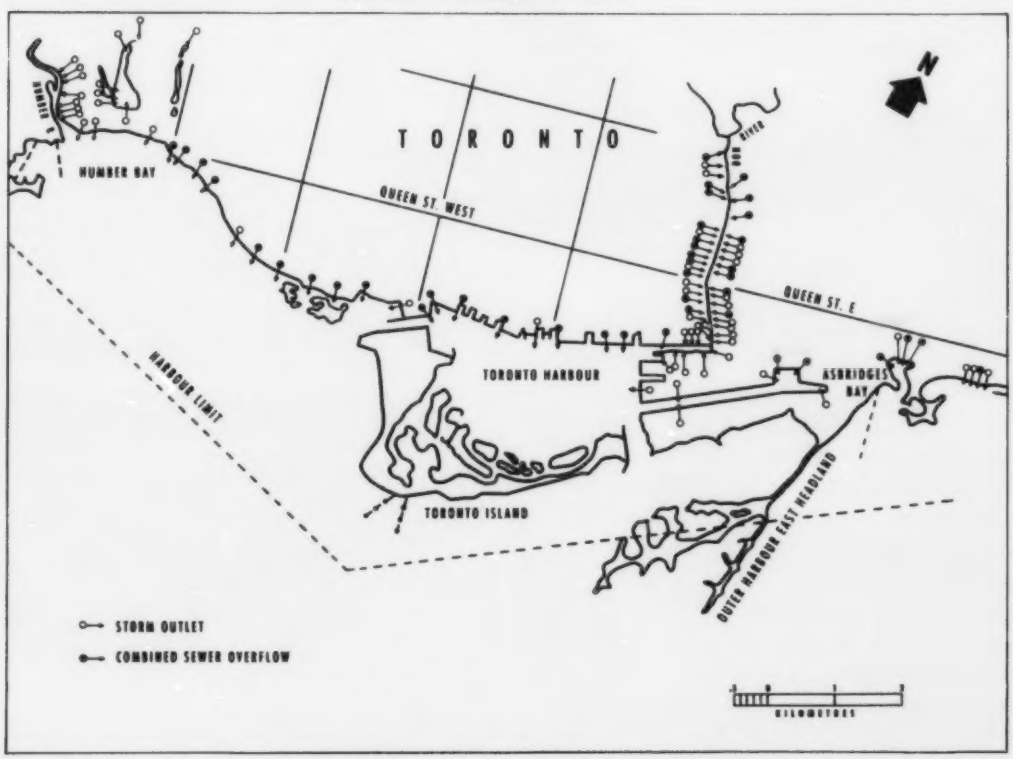

Figure 9: Location of Storm Outlets and Combined Sewer Overflows

ironically, this doesn't happen, (except west of Mimico Creek). This is due to two factors - a lack of suitable material on the lake bottom and the murkiness of the water which hinders plant growth by blocking sunlight.

Non-Point Sources:
Two hundred years ago, non-point source pollution was not a problem in the Metro RAP area. When rain fell, it would be absorbed by the soil and vegetation in the complex of plant and animal communities which made up the forest.

Today, in the parts of the RAP area which are still relatively natural, this is still the case. However, in agricultural areas where farming takes place, rain causes soil to erode, and then carries soil particles into creeks, streams and rivers, and eventually into Lake Ontario. Nutrients from fertilizers, bacteria from livestock and manure, and traces of pesticides and herbicides dissolved in the water are attached to these soil particles. Erosion is also a problem during construction activities in such areas, such as the building of new housing subdivisions.

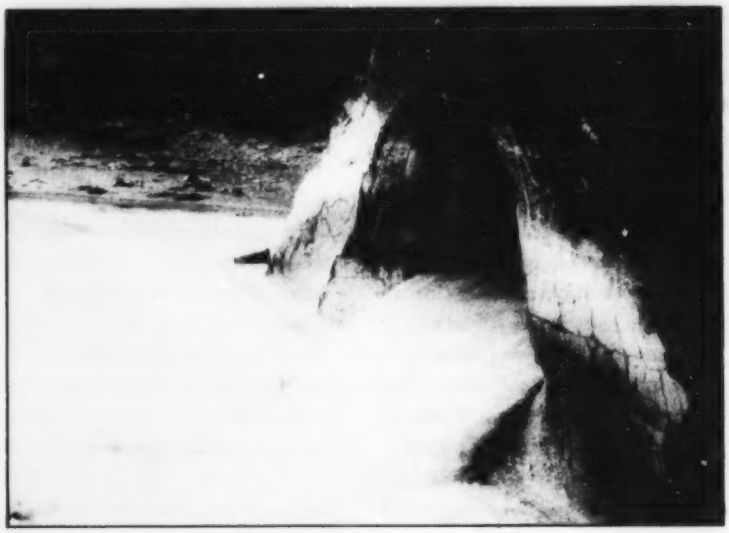

Figure 10: Stormwater outfalls deliver non-point source pollutants to the waters in our area

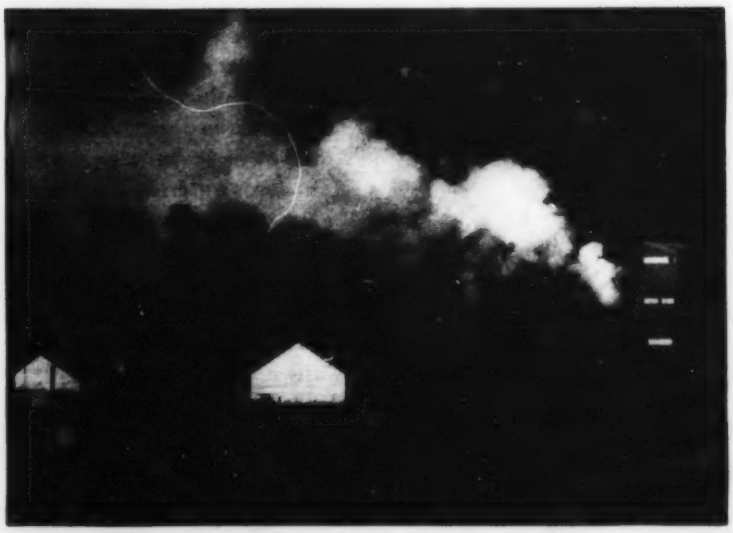

Figure 11: Little is known about the impact of fallout of toxic contaminants onto water

In urban areas, a vast proportion of the landscape is totally impervious to rain. When rain falls on streets and highways, parking lots or roofs of buildings, it is funnelled into storm sewers which are designed to collect and transport it to the nearest water body and prevent flooding from occurring. Before it reaches the storm sewers, however, the swirling water picks up a host of contaminants - bacteria from pet and wildlife faeces; particles of dirt; pesticides from lawns; salt from winter de-icing operations; and oil, grease, lead and other pollutants from automobiles and industries. Storm sewers discharge their load of rainwater and contaminants through 2,250 outfalls which empty into the creeks, rivers and waterfront in the Metro RAP area.

A few decades ago, it was believed that stormwater was fairly clean, and attempts to control pollution focused on sanitary sewage. We now know that the quality of stormwater can rival that of combined sewer overflows. Stormwater can be a significant source of pollutants such as copper, lead and zinc to the aquatic environment. The sediments carried by stormwater can cause silting of creeks, rivers and connecting channels; in areas such as the Keating Channel at the mouth of the Don River, this requires ongoing dredging to allow navigation and reduce the risk of flooding upstream.

With the realization that urban stormwater can carry a significant load of pollutants, much work has been done to devise methods of reducing its impacts. One such local effort was the construction by the City of Toronto of a detention tank in the Eastern Beaches for stormwater and combined sewer overflows. The tank is designed to hold this water until the storm has passed, whereupon it is sent to the Main Sewage Treatment Plant.

Other Sources:
To be comprehensive, the Metro Toronto and Region RAP needs to identify all the sources of pollution. Although they may be of less significance than point source and non-point source pollution, these other sources do contribute to the load of toxic contaminants and nutrients entering the aquatic environment.

Pollutants can fall out from the air as dry particles, or as wet (in rain). That portion which falls onto land gets picked up by stormwater and then becomes part of the non-point source problem. That portion which falls out directly onto water may also affect water quality. Unfortunately, little is known about the magnitude or importance of fallout of toxic contaminants onto water. To address this problem, the Ontario Ministry of the Environment has established a monitoring station on the Toronto Islands as part of a Great Lakes Basin-wide initiative to gather information on the atmospheric fallout of toxic compounds.

Faeces from waterfowl such as Canada geese, ducks and gulls likely contribute to problems with bacteria in localized areas where these birds are found in high numbers. Although it has not been measured, this is particularly a problem in the Western Beaches area. Other sources of pollution include discharges from commercial and private ships, and boats and contaminated groundwater. Groundwater can be contaminated by leaking underground storage tanks, spills, contaminated soil and landfill sites.

Lake Ontario is the last in the string of Great Lakes, and is potentially affected by all the pollution which occurs in the upper lakes. One of the important upstream sources is the Niagara River, through which passes most of the water entering Lake Ontario. Binational efforts to reduce the discharges of industrial chemicals into the Niagara River, including the development of a Remedial Action Plan, have been underway since 1984. The water quality in the river is still far from adequate, but it is difficult to determine what influence it has on the water in the Metro Toronto RAP area.

Even if one could wave a magic wand today and "turn off the taps" which discharge nutrients and toxic contaminants into the waters of the Metro Toronto and Region RAP area, these pollutants would still be a

problem for many years to come. This is because the contaminants in the bottom sediments - nutrients, heavy metals and organic chemicals - will continue to leach out until they break down, get buried under new sediment, or are removed. Although much work needs to be done to understand how contaminants behave in sediments, we know that they can affect the aquatic environment. This is covered in the **Linkages** section of this chapter.

Introduction of Foreign Species

Non-native or foreign species of plants and animals are introduced by humans, sometimes by accident, and sometimes by design. In either case, they can wreak havoc when introduced, because they often have no natural predators here. In the Metro RAP area, there are many foreign species which appear from a human standpoint to be merely a nuisance - the European starling, for example. Others, such as the sea lamprey have had an immediate and dramatic impact on the environment after introduction.

The parasitic sea lamprey is an aquatic species which first reached the Great Lakes in the 1830s after the building of the Erie Barge Canal provided a link with the Atlantic Ocean. In the lamprey's heyday, its voracious appetite contributed to declines in populations of some species of fish native to Ontario. Happily, through a combination of physical and chemical controls, the lamprey is not the problem now it was twenty years ago.

The zebra mussel, however, is another story. Carried to the Great Lakes in the ballast water of European ships, the tiny mussel is spreading rapidly and reached the Toronto area in 1990. It covers fish-spawning habitat and deprives fish of food by eating vast amounts of plankton. It also attaches itself to the hulls of boats which then require expensive maintenance programs. The prolific zebra mussel is attracted to and can eventually block the intake pipes of water used by municipalities, industries and utilities.

Just one of the important foreign plant species is purple loosestrife. It is both beautiful to look at, and tremendously invasive. Purple loosestrife has taken hold in most of the wetlands in the Metro RAP

Figure 12: Zebra Mussels (from Ontario Ministry of Natural Resources)

area, displacing other indigenous plants and upsetting the food webs in these wetlands.

The list of introduced plant and animal species is long and includes such household names as the house sparrow, the pigeon and eleven species of fish including carp, rainbow smelt, alewife, Pacific salmon and rainbow trout. Each has, in its own way, altered the complex and balanced web of life in this area. It might also be said, however, that none has caused more dramatic change than has the human in the last 200 years.

LINKAGES

One of the most important ecological lessons which has been brought home in the last few years is that of "interconnectedness" - how air and water and land and living organisms are linked. We see the interconnectedness at work in the Metro Toronto and Region RAP area.

Most of the toxic contaminants introduced into the aquatic environment enter in a liquid form, and are discharged through pipes into waterbodies. (As already pointed out, the main discharge pipes are the outflow pipes from the five sewage treatment plants serving the area, the 69 combined sewer overflows, and the 2,250 storm sewer outflows.) If one were to sample the effluent coming from such pipes, one could measure the concentrations of lead or copper or phenols or toluene which are being deposited into the water. But these toxic contaminants do not necessarily remain a water problem.

Because of gravity, particles tend to settle to the bottom of waterbodies, taking pollutants with them, and become part of bottom sediments. If we test these sediments, we can map out the "hotspots" or places with high levels of nutrients and toxic contaminants. In general, these hotspots occur in areas with poor water circulation (such as embayments and boat slips) and near outflow pipes.

Pollutants can, however, move from bottom sediments. If disturbed by wave action or dredging, pollutants can become re-suspended in water. They can also be absorbed by bottom-dwelling invertebrates such as freshwater clams and worms. When a chemical or metal is found in the tissues of a plant or animals at concentrations greater than in the surrounding sediment, it is said to have been "bioconcentrated." Examination of invertebrates in Humber Bay, the Inner Harbour and around the outfall of the Main Sewage Treatment Plant, show that bioconcentration of some organic compounds and metals such as copper, zinc and mercury is occurring. Whether this is having an adverse effect on these organisms is not yet known.

In the natural world, almost everything is a potential dinner for something else, and so it is with bottom-dwelling invertebrates. They get eaten by small fish which get eaten by bigger fish, which in turn get eaten by gulls or perhaps by anglers. As one moves up the food chain from the invertebrates on the bottom rung to the top predators (such as gulls or humans), the concentrations of toxic contaminants in tissues increase. This can differ from chemical to chemical. PCBs in eagle eggs from Lake Erie, for example, contain concentrations of PCBs which are 25 million times higher than the concentrations in the water. For mercury, tissue levels are on the order of 1000 times higher than the concentrations in water.

Contaminant levels in sport fish have been measured since the 1960s, and the Ontario Ministry of the Environment (with the Ministry of Natural Resources) has published results in the *Guide to Eating Ontario Sport Fish* since 1976. Based on contaminant levels found, the Guide provides advice to the public on eating various species of fish. The Guide advises restrictions in eating some sizes of 17 species in the RAP area because of mercury, mirex and PCBs. This information is presented in Table 1.

Location	Species	Length in Centimetres								
		15-20	20-25	25-30	30-35	35-45	45-55	55-65	65-75	>75
Marie Curtis Park	White Sucker		✓	✓	✓	✓				
Long Branch	White Sucker			✓	✓	✓				
	Lake Trout		✓	✓	✓	✓	●	●	●	
Humber River mouth	Brown Trout					✓	✓	●	●	
Humber Bay area	Rainbow Smelt	✓	✓							
	Lake Trout		✓	✓	✓	✓	●	●	●	
	White Sucker	✓	✓	✓	✓	✓	✓			
	Rainbow Trout		✓	✓	✓	✓	✓			
	Yellow Perch		✓	✓						
Hearn Generating Station, Outer Harbour	Carp								●	●
	White Bass		✓	✓	✓	●				
	White Perch	✓	✓							
	Yellow Perch	✓	✓	✓	●					
	Rainbow Trout		✓	✓	✓	✓				
	Brown Trout			✓	✓					
	Gizzard Shad				✓	●	●			
	Northern Pike				✓	✓	✓	✓	✓	●
	Rainbow Smelt	✓	✓	✓						
Toronto Island, Inner Harbour	Rainbow Smelt	✓								
	Yellow Perch	✓	✓	✓	✓					
	White Sucker			✓	✓	✓	●			
	Northern Pike						✓	✓	✓	●
	Carp						✓	✓	●	●
Ashbridges Bay	Rainbow Smelt	✓								
	White Sucker				✓	✓	✓	✓	✓	
	Brown Trout									
Scarborough Bluffs	Lake Trout					●	●	●		
	White Sucker		✓	✓	✓	✓	✓			
	Yellow Perch	✓	✓							
	Brown Trout						✓	●	●	
Rouge River mouth	Brown Bullhead		✓	✓	✓					
Eglinton Flats Pond	Brown Bullhead		✓	✓	✓					
	Goldfish		✓	✓						
Grenadier Pond	Black Crappie	✓	✓	✓						
	White Perch	✓	✓							
	Pumpkinseed	✓								
	Brown Bullhead		✓	✓	✓					
Heart Lake	Largemouth Bass	✓	✓	✓	✓	✓				
	Rock Bass	✓								
Humber River (Queensway Marsh)	Brown Trout			✓	✓	✓	●	●		
Milne Reservoir	Rock Bass	✓	●							
Professor's Lake	Rock Bass	✓	✓							
Rouge Marsh	Brown Bullhead	✓	✓	✓						
West Don River	Rock Bass	✓								
	Brown Bullhead		✓	✓						
West Humber River	Largemouth Bass		✓	✓	✓	✓				
	Brown Bullhead	✓	✓	✓						

LEGEND

✓ no restriction on consumption

● consumption restricted

Table 1: Restrictions on Fish Consumption in the Metro Toronto and Region RAP Area

The Metro RAP area is particularly rich in fish-eating birds who, like humans, are top predators in the aquatic food chain. In the Great Lakes, much study has been made of five species which commonly nest in the RAP area - ring-billed gull, double-crested cormorant, herring gull, common tern and black-crowned night heron. Across the Great Lakes Basin (and in the RAP area), populations of all these birds crashed in the early 1970s because of eggshell-thinning due to DDT, and the effects of other persistent toxic chemicals on embryonic development. Populations of these birds have increased since the use of DDT and similar pesticides was restricted in the early 1970s. In the case of ring-billed gulls, the population has ballooned to become one of the largest in Canada.

Levels of chlorinated organic compounds in herring gull eggs from the Metro RAP area dropped significantly between 1974 and the early 1980s. Since then, levels have remained essentially constant, probably due to atmospheric deposition and re-suspension of contaminants in bottom sediments.

We have seen how contaminants can move from water to sediment to the tissues of invertebrates, fish and fish-eating organisms. Other links also exist - humans drink water, for example, as well as eating the fish which live in it. Organic compounds which are volatile in water can evaporate to become an air problem. These pathways are illustrated in Figure 13.

THE REGULATORY ENVIRONMENT

If one had to select an adjective to describe the existing regulatory environment in the RAP area, it might be "disjointed" - a system characterized by jurisdictional fragmentation and lack of coordination.

In part, this is because the traditional way of protecting the environment has been to try and protect the individual compartments of the environment - the air, the water, the land, or living organisms. With such compartmentalizing, sometimes the view of the overall picture got lost. Often, as well, insufficient effort was spent on examining the relationships between the compartments of the environment - how air quality could affect water quality, or how soil quality could affect wildlife.

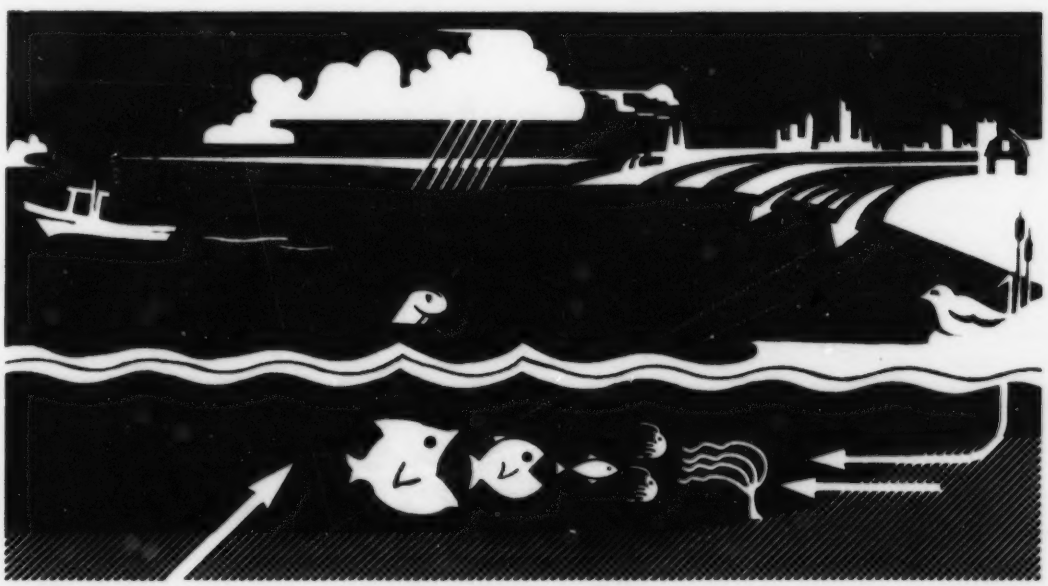

Figure 13: Pathways for Contaminants in the Aquatic Ecosystem

Today, the role of environmental agencies is changing. Where once they functioned primarily as regulators, now environmental agencies are becoming more involved in assessment, planning, prevention and remediation. Agencies are also moving towards more "holistic" ways of protecting the environment. (One of these methods - the "ecosystem approach" is covered in Chapter 2.)

Moving towards more holistic ways of decision-making requires the use of a broad definition of the "environment". This means taking into account, not just the natural environment, but also the social and economic environments as well. Finding a way of making decisions which integrates the natural, social and economic environments may be one of the great challenges of the 1990s.

Another factor contributing to regulatory fragmentation is that responsibility for the environment has traditionally been shared among many regulatory authorities. In the Metro RAP area, responsibility for aspects of the aquatic environment is shared by four levels of government and about 30 government agencies. The Ontario Ministry of the Environment is primarily responsible for protecting our waters and the Ontario Ministry of Natural Resources is responsible for protecting wetlands and fisheries. The federal Departments of Environment, Transport, Public Works and Fisheries have responsibilities for shipping, navigation, fisheries and, to a limited extent, water quality.

Toronto's harbour, being a federal port, is to a large degree controlled by the Toronto Harbour Commission, a federal crown corporation. Among its other roles, the Metro Toronto and Region Conservation Authority has responsibility for flood and erosion control, and conservation of area lands and waters. Metro Toronto itself owns and operates the water and sewage treatment plants in the area, along with large (trunk) sewers and water lines. Smaller water and sewer lines are the responsibility of the local municipalities in the area.

One group which has a somewhat less-defined, but nevertheless crucial role to play in the RAP area is the public. The public includes interested individuals, community groups and organizations representing all sectors of society. With regard to the aquatic environment, the public plays a number of roles - watchdog, researcher and advocate. In the Metro RAP area, at least four grassroots groups dedicated to cleaning up parts of the aquatic environment have sprung up in the past few years - The Black Creek Project, Save the Rouge Valley System, the Task Force to Bring Back the Don and ARCH (Action to Restore a Clean Humber). National organizations such as Trout Unlimited are also active in the area. These groups bring enthusiasm, imagination and hands-on dedication to cleaning up our waters.

If the sheer number of agencies, boards and commissions involved in the aquatic environment is a problem, so too, is the frequent lack of coordination amongst them. In some cases, formal opportunities for inter-agency consultation have not been used; in others, the consultations have been time-consuming and unwieldy. Better environmental decision-making will require more emphasis on inter-agency communication, cooperation and coordination.

The Metro RAP process attempts to achieve this. It involves four levels of government along with the public and is an example of task-oriented consultation with the involvement of all the stakeholders. The list of people involved can be found in Appendix B. Together, the parties are working to ensure that the finished plan will be comprehensive, coordinated and able to be implemented. The plan will address all the problems which have been identified - closed beaches, contaminated sediments, contaminants in wildlife, degradation and loss of habitat.

Many of the people involved in developing the Metro Toronto Remedial Action Plan believe that it is the best chance we have to restore the health of the waterfront and its watersheds - and that we must make it work.

All planning processes need targets to aim for, objectives against which progress can be measured. And so it is with the Metro Toronto Remedial Action Plan. When people came together to begin to develop the RAP, some of the first questions asked were: "What are we aiming for?" and "How clean is 'clean?'"

To answer those questions, the Public Advisory Committee developed a set of RAP goals through a long and difficult process of consultation and presented them to the RAP Team in the summer of 1989. These goals were developed with input from all sectors - industry and recreation, environment and community groups, municipalities and interested individuals. The complete list of goals can be found in Appendix A to this report.

Figure 14: The Toronto Islands provide some protected habitat for wildlife

The RAP goals can be divided into two categories. Some of them deal with where we would like to be. Others relate more to how (in a broad sense) we should get there. This chapter deals with both categories, in order.

Goal setting is always influenced by the biases of those who select the goals. To this end, the RAP goals reflect a human-centred (or "anthropocentric") viewpoint. Most of the goals speak to cleaning up the environment to make it safer or more enjoyable for humans. A few of the goals, though, can be thought of as "biocentric" (or centred on nature, not humans). Examples of these are the goals which speak to the need for protection and enhancement of wildlife habitat in the area. Behind such goals lies the belief that wildlife has a right to exist, independent of usefulness to humans.

THE RAP GOALS: WHERE WE ARE GOING

Goal 1: Ecosystem Health

The first - and overarching - goal set for the Metro RAP is that of ecosystem health. "Toronto's waterfront and watersheds should be a diverse, healthy, integrated ecosystem".

The term "ecosystem" is a relatively new one for many people. At its simplest, an ecosystem consists of air, land, water and living organisms (including humans) and the

interactions among them. One of the fundamental phrases used to describe an ecosystem is "everything is connected to everything else." Although we may not have known it 20 years ago, we now know that if we alter one compartment of the environment, its effects will be felt elsewhere, like ripples on a pond after a stone is thrown in. If, for example, a kilogram of mercury is sent up a smokestack, traces of that mercury will eventually be found on land, in water and in the tissues of plants, animals and humans.

Ecosystems can exist at different scales. A small pond can be considered an ecosystem. It is a community of plants and animals linked by their dependence on the pond's water and the energy and nutrients which cycle through the system. Examples of larger ecosystems include the Humber River Watershed, the Lake Ontario Basin, and the Great Lakes Basin. The largest ecosystem is the biosphere itself - the globe. The Metro Toronto and Region RAP consists of six major ecosystems - the watersheds of the Don, Humber and Rouge Rivers, and Mimico, Etobicoke and Highland Creeks.

Although ecosystems can be drawn on a map, their "boundaries" are defined by ecological factors, in contrast to the myriad political boundaries which carve up our landscape into arbitrary bits. Indeed, it is important to know that the "boundaries" between ecosystems are often blurred - energy, nutrients, pollutants, plants and animals can and do cross boundaries between these dynamic systems. Humans, in particular, have the capacity to effect changes in ecosystems, even remote ones, through their activities.

Scientists say that a healthy ecosystem has "integrity," or the ability to maintain its organization. If healthy, an ecosystem has resilience (the ability to cope with external stresses), productivity and balance. If ecosystems are overstressed, like the proverbial camel whose back is broken by one straw too many, they can collapse.

This goal begs the question: How do we measure the health of an ecosystem? How unhealthy is the ecosystem in the RAP area now? How will we know when it is has reached a state of health?

Where this has been attempted elsewhere, "indicators" of ecosystem health have been developed. Just as a temperature of 37.5 degrees Celsius (98.6 degrees Fahrenheit) is an indicator of human health, measures can be found to estimate the health of an ecosystem. Although this has not yet been done for the Metro RAP, such indicators could include such measures as "acceptable" levels of contaminants in animal tissues, diversity of wildlife, or beaches open all summer for swimming.

Goal 2: Fishable, swimmable, drinkable

The second RAP goal deals with water quality. The goal states that "Toronto's watersheds and nearshore zone should provide citizens with fishable, swimmable, drinkable and aesthetically pleasing water and aquatic habitats." These adjectives are defined in the goals.

Figure 15: Beach Closures are a regular occurrence in the Metro RAP Area

There are a number of ideas contained in the goal as articulated. One set of ideas deals with aquatic life. The RAP goal is to achieve naturally-reproducing populations of indigenous varieties of fish which have sufficient habitat to support themselves. Levels of organic and metal contaminants in these fish should not pose a problem for people eating them.

A second set of ideas deals with recreational uses of the waterfront and other waterbodies. People should be able to engage in water sports such as swimming and boardsailing without fear of disease or exposure to unsafe substances. The aesthetic quality of Metro Toronto's waterfront, river valleys, ravines, wetlands and waterbodies should enhance human recreational use.

The third set of ideas deals with drinking water. The goal adopted for the Metro Toronto and Region RAP is that levels of potentially toxic chemicals in Toronto's drinking water should not exceed acceptable health standards which have been set using the "best scientific methodology available." Toxic chemicals for which standards do not exist, should not be found in treated drinking water. The same high standards should apply to other communities in the RAP area which use groundwater rather than Lake Ontario water for drinking.

Goal 3: Discharges to Waterbodies
The greatest impacts on water quality in the Metro RAP area are stormwater runoff, combined sewer overflows and sewage treatment plants, all of which discharge directly to rivers or Lake Ontario.

The goal set for the RAP is that such discharges should not contain bacteria or hazardous chemicals at levels which disallow other "beneficial" uses of the water (such as swimming, fish habitat, etc.). The discharges should not inhibit aquatic life or produce other adverse impacts on the ecosystem. The goal also states that there should be "zero discharge" of persistent toxic chemicals. Persistent toxic chemicals are those which have been shown to be toxic to humans or wildlife, and which last in the environment for a long time before breaking down. Because of these characteristics, the philosophy of zero discharge of persistent toxic chemicals is part of the binational Great Lakes Water Quality Agreement, which was first signed in 1978. It is also the long-term goal of Ontario's MISA program which is designed to reduce industrial and municipal discharges to Ontario's waters.

Goal 5: Public Access
Parts of the Metro Toronto waterfront and river valley systems are in private ownership, and therefore usually not accessible to the public. One of the goals of the RAP is that people should have access to the waterfront and valley systems for recreational and cultural activities.

Goal 6: Sediments
Some sedimentation occurs naturally in aquatic systems. The Toronto Islands, for example, were created by sediment eroded from the Scarborough Bluffs and carried westward by the Lake's currents. Human activities, however, have dramatically altered both the quantity of sediment produced in the RAP area and its quality. Especially during rainfalls, large amounts of sediment are washed down Toronto's creeks and rivers. This sediment originates from many sources - agricultural erosion, poor construction practices, the erosion of stream banks and material deposited from the air onto streets, roofs and parking lots. When this material gets flushed down rivers, it often carries a load of toxic heavy metals and organic contaminants.

The RAP goal set for sediment is that the quantity (or volume) of sediments being deposited in Toronto's watersheds should be stabilized at near-natural levels through control at point of origin. Such sediments should be free of persistent (long-lived) contaminants and contain safe levels of those contaminants which are non-persistent.

Goal 7: Lakefilling
Much of what is now "waterfront" in Metro Toronto was, in fact, created by lakefilling. The extent of the filling which has been done is illustrated in Figure 4 in Chapter 1. While lakefilling can create recreational opportunities for humans and provide habitat for fish, it can destroy valuable aquatic habitat, cause changes in fish communities, alter currents and can adversely affect water while construction is occurring. Before the late 1980s, there was no rigorous monitoring to control the level of pollutants allowed in fill, and lakefilling projects were often built with contaminated materials.

The RAP goal dealing with lakefilling states that the practice should not be allowed unless it can be shown that it will not impair the aquatic ecosystem. The goal goes on further to say that if a lakefilling project is being considered, all possible means of improving the environment should be considered in the planning process.

Goal 8: Atmospheric Deposition
Atmospheric deposition is the depositing of wet or dry material from the air onto land. Acid rain is an example of wet atmospheric deposition; the fallout of dust from a highway is an example of dry. The goal set for the RAP is that the atmospheric deposition of potentially hazardous substances (of human origin) should have no adverse impacts on the ecosystem.

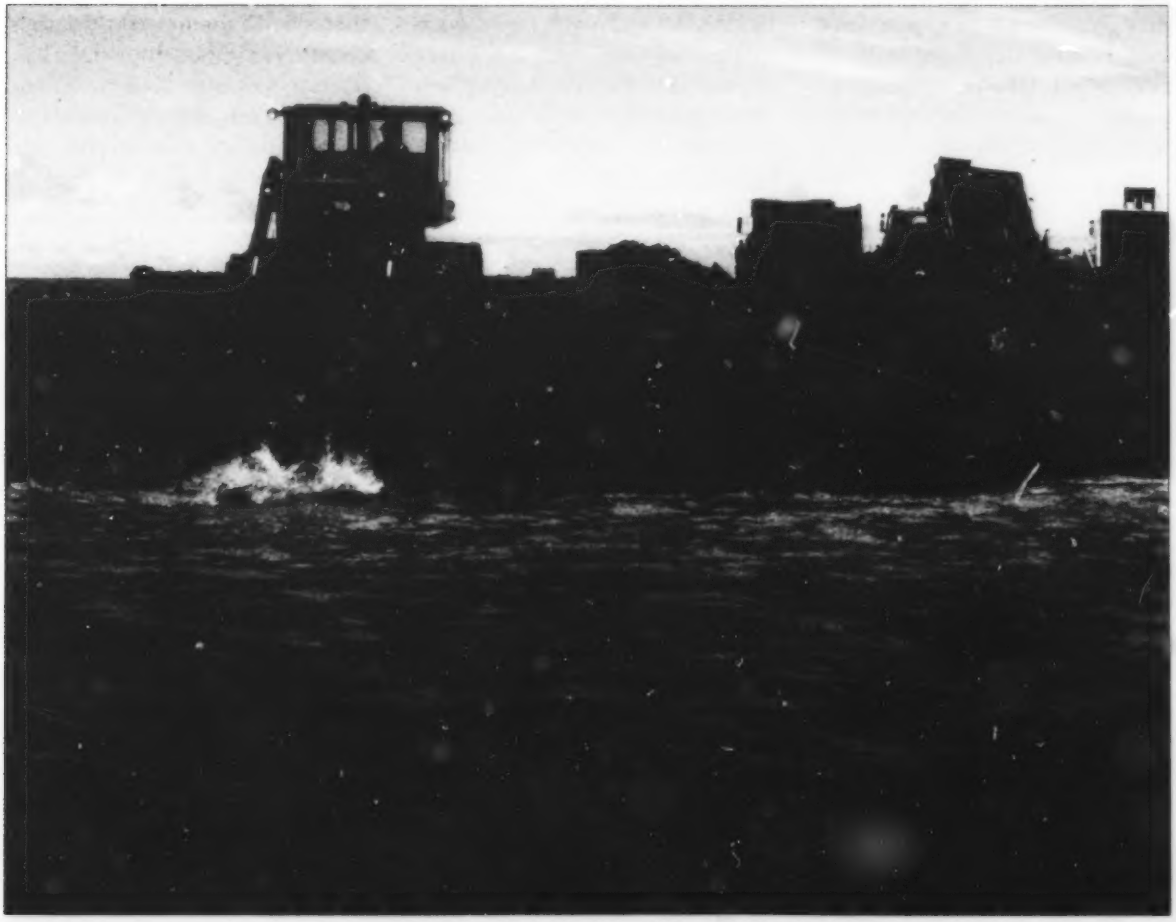

Figure 16: Trucks dump lakefill in the Toronto Harbour

Goal 10: Navigation and Recreation
The waters around Metro Toronto are used for a wide variety of activities. Shipping and boating are two uses which, although they serve economic and social ends, can have an adverse effect on the aquatic ecosystem. Due to the amount of sediments deposited in the Metro RAP area, periodic dredging of boat slips and connecting channels is required in order that safe navigation can take place.

This RAP goal states that navigational and recreational uses in the Metro RAP area should be maintained. In order to support this, the option of dredging should be available as long as it is carried out in an environmentally acceptable manner.

THE RAP GOALS: HOW TO REACH THEM

A number of the RAP goals speak, in a very broad sense, to how we should get to where we want to be. This section examines these goals.

Goal 1: Ecosystem Approach
The first, and most fundamental "how to" is that an "ecosystem approach" should be used to develop the RAP and to manage human activities. The ecosystem approach is a comprehensive one which recognizes the interconnectedness of air, land, water and living things, rather than compartmentalizing them. The ecosystem approach:

- considers the whole system, not just parts of it;
- focuses on inter-relationships among the elements;
- uses a broad definition of "environment" which includes the natural, social, cultural and economic environments;
- is based on natural ecological units rather than political boundaries;
- understands that humans are part of nature, not separate from it;
- explicitly recognizes the importance of species other than humans and generations other than our own;
- recognizes the influences of local, regional and international activities;
- recognizes the dynamic (ever-changing) nature of ecosystems; and
- recognizes the concept that there are limits to sustainability.

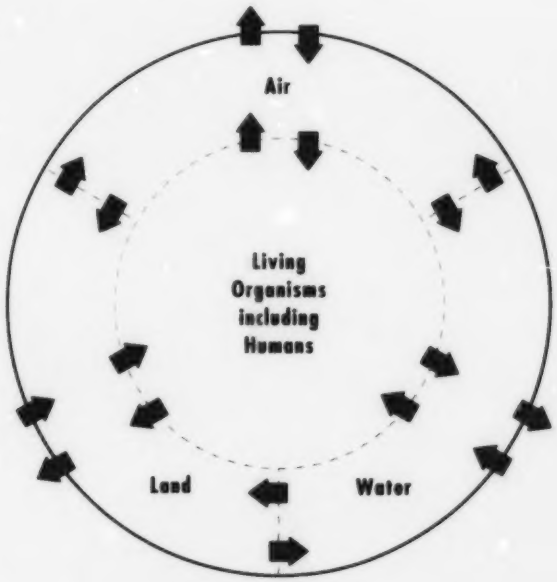

Figure 17: The Ecosystem Approach: "Everything is connected to Everything Else"

Goal 4: Costs of Cleanup
This RAP goal affirms the "polluter pay" principle - that the costs associated with controlling pollution and rehabilitation should be borne by those who are the source of the pollution. In some cases, it is relatively easy to determine who the polluter is. It may be a particular individual, institution or industry. It can also be the taxpayers living in the Metro RAP area. This would certainly be the case for pollution from stormwater or the sewage treatment system. In some cases, though, where the pollution occurred in the past, it is not possible to fulfil this principle. This is true in the case of contaminated bottom sediments or soils, where we are often dealing with historical problems. In such situations, the costs of cleanup must be borne by the general taxpayer.

Goal 4a: Cost-Effectiveness
This RAP goal states that when decisions about priorities for improving water quality are being made, an analysis of cost-effectiveness should be undertaken. This would entail an estimation of the amount of improvement which would be obtained if a remedial option was implemented versus the amount of money spent.

Goal 9: Coordination with Other Programs and Plans
There are many programs and plans addressing Great Lakes water quality issues which being developed independently but concurrently with the Metro Toronto and Region RAP. Coordination and communication among these initiatives can ensure that duplication of effort does not occur, and that the needs of the Toronto RAP are considered elsewhere. This goal states that the Metro Toronto and Region RAP should have input into the development of these where they have a significant impact on water quality in the area. Such initiatives could include the Lake Ontario Toxics Management Plan and other upstream RAPs such as that being developed for the Niagara River.

Goal 11: Public Awareness and Consultation in the RAP Development
This RAP goal recognizes the importance of public input and states that public awareness activities and consultation should continue throughout the RAP's implementation phase. After implementation starts, the public will have an important role to play in evaluating the progress of remedial options and the overall Remedial Action Plan.

Goal 12: Monitoring and Review
This RAP goal states that there should be a mechanism which allows a regular review of the RAP goals and the progress of the Remedial Action Plan itself. This goal reflects the fact that public priorities can change over time, so that a process should be developed to allow periodic review of the goals and adjustment, if required. Monitoring the progress of the Remedial Action Plan is vital in order to be able to assess progress and whether goals are being reached.

As outlined in Chapter 1, the environmental problems on the Metro waterfront are complex and often interrelated. It probably comes as no surprise that the solutions are also complex. But how to proceed? Of the many possible solutions to each problem, which are the best in terms of the environment? How can we choose?

The suggested answer, in terms of the RAP process, is to allow decisions to be guided by a set of principles. These RAP principles, and their implications are outlined in the next section of this chapter. It is believed that these principles will help in two ways. First, they can guide the development of the overall Remedial Action Plan. Secondly, we believe that they can also assist in the difficult task of selecting and prioritizing remedial options.

Figure 18: Common Terns nest on rafts at Leslie Street Spit (from Canadian Wildlife Service)

The wide variety of remedial options which have been identified to date are outlined in the second section of the chapter. The chapter ends with an evaluation of two of these options against the RAP principles.

THE RAP PRINCIPLES

In order to guide decision-making in the Metro RAP process, a set of RAP Principles were developed (see box). These principles were derived at a workshop which involved representatives from the Public Advisory Committee, the Scientific Advisory Committee, the Technical Advisory Committee, and the RAP Team. As such, the principles represent a consensus position in the RAP process.

It is perhaps useful to examine these principles and their implications to see what they mean for the RAP process, in particular for the selection of remedial options.

The first principle is that "water is a basic necessity of life and should be conserved." Moreover, "its quality should be protected and restored." This principle recognizes in a general way the importance of water to our continued existence on this earth. It suggests that, like other natural resources, water should be conserved, (that is, not wasted). In the RAP area now, water is used inefficiently and a great deal is wasted. Efficient use of water can mean less strain on the environment and on the taxpayer's pocketbook.

The second half of the principle addresses the issue of quality: Where water is clean, it should be protected and where it is not clean, it should be restored. This suggests that effort should be spent on protecting those areas - such as the headwaters of the Don and Humber and the Rouge River - where water quality is still quite good. It also suggests that efforts should also be made to clean up the middle and lower reaches of the Don and the Humber and along the waterfront where water quality ranges from fair to poor.

The second principle (which is also a RAP goal) is that the waterfront and watersheds should be managed using an ecosystem approach. The implications of this are far-reaching. For example, it suggests that solutions which merely transfer a problem such as toxic chemicals from one medium (water) to another (air or land) would not be acceptable.

The principle also suggests that before selecting remedial options, one needs to have an understanding of the effects of implementing each option on the ecosystem. This implies a fairly sophisticated understanding of the effects of a particular action or set of actions. It is not enough, according to the ecosystem approach, to look only at the effects on the natural environment - effects on the social and economic environments must also be considered. How much will the remedial option cost?

Metro Toronto and Region RAP Principles

1. Water is a basic necessity of life and should be conserved. Its quality should be protected and restored.

2. The waterfront and watersheds must be planned and managed using an ecosystem approach. Ecosystem means using a comprehensive and systematic consideration of interacting components of air, land, water and living organisms, including humans.

3. The RAP goals form the basis for RAP action.

4. Environmental decision-making and the selection of remedial options should be coordinated and involve the participation of all stakeholders. Stakeholders include all perspectives, for example: all levels of government, the private sector, non-governmental organizations, conservation groups and agencies, community groups and individuals.

5. We are all polluters and must be part of the solution.

6. Public awareness and education, including access to information, are important to the success of all stages of the RAP.

7. Both voluntary action and legislation should be considered as a means of implementing remedial actions.

8. Source control shall be an objective of the RAP and take priority over end-of-pipe solutions.

9. Neither dilution nor dispersion should be considered satisfactory substitutes to reducing pollution.

10. There should be zero discharge of persistent toxic chemicals.

11. The RAP should encourage and review research that supports RAP principles, but research must not be allowed to be an excuse for inaction.

12. Implementation consistent with RAP goals and principles should proceed along with development of the RAP.

13. In addition to remediation, the RAP must include and encourage preservation, conservation, rehabilitation and prevention.

14. The RAP goals and applicable remedial actions should be integrated into land use planning and construction approvals.

15. A RAP implementation action should be led and coordinated by the appropriate and clearly defined and mandated party.

16. An integrated and coordinated program of environmental monitoring and reporting of progress is essential in developing, implementing, evaluating and revising the RAP.

What are the costs of inaction? Who will pay? How will communities or individuals be affected by the remedial option? What are the positive and negative impacts of implementation? These are the kinds of questions which arise from the use of an ecosystem approach.

The third principle is that the RAP goals should form the basis for RAP action. This is an important tie to the goals which have already been set. For example, one could ask: Will a particular remedial option help to meet a particular goal (or goals)? Will the overall package of options - that is, the Remedial Action Plan itself - meet the RAP goals? In terms of water quality, will Toronto's waters be swimmable, drinkable and fishable?

The fourth principle is that environmental decision-making and the selection of remedial options should involve all stakeholders. The implications of this are that those people who have a stake in a decision - those who will be affected by it - should be involved in the making of that decision. This principle is respected in the RAP process with its committee structure which explicitly includes all sectors. At key decision points, this process opens up even more with formal consultation of the general public who, after all, are the taxpayers who will pay many of the RAP bills, and will also be the beneficiaries of cleaner water.

Principles five, six and seven are all related in that they deal with individuals. The fifth principle is that "we are all polluters and must be part of the solution." First, this recognizes the impacts that we all make on water quality, those of us who live and work in the Metro RAP area. Through the amount of water that we use, through the products we pour down the sink or flush down the toilet, through the pesticides we use, through our day-to-day living we contribute to the stress on our ecosystem.

Taking responsibility for our actions requires access to information about the environment. This includes educational programs to make us aware of the impacts of our lifestyle on the environment and the opportunities for individual action (principle six) so we can act. Taking responsibility also means accepting that government legislation alone cannot fix the myriad problems in the RAP area (principle seven). To solve them, citizens, through individual voluntary actions need to become involved.

Principle eight is that "source control shall be an objective of the RAP and (shall) take priority over end-of-pipe solutions." End-of-pipe solutions include such technologies as filters and settling tanks which can "remove" pollutants from industrial effluents. However, in these kinds of technologies, the pollutants (if they are metals or persistent organic chemicals) do not go away - they remain as a sludge on the filter or on the bottom of the tank. This sludge must then be disposed of in a landfill (where contamination of groundwater can take place) or incinerated (where the pollutants can go up the smokestack and can fall out onto land or water). End-of-pipe solutions usually protect surface waters at the expense of air, soil or groundwater.

Control-at-source usually means reducing or eliminating the use of a toxic material at source. One way of accomplishing this is to substitute a non-toxic alternative for a toxic compound, if one is available. Another technique which is sometimes feasible is to use "closed loop" systems in which there are no discharge pipes, and therefore no discharges to the environment. Principle eight states that remedial actions which involve source reduction will be given precedence over those which do not.

Principle nine is that "neither dilution nor dispersion should be considered satisfactory substitutes to reducing pollution." The local impacts of a discharge pipe can be reduced

by extending the pipe further out into the lake. If one did this, for example, with the pipes which carry overflows from combined sewers to the waterfront, the concentrations of bacteria at the beaches would be reduced and they would be closed less frequently. This solution, however, does not reduce the amount of pollution being sent through the pipe - it only disperses it farther away (making it someone else's problem). Such solutions treat the symptom, not the disease. The problems of acid rain and persistent toxic contaminants have taught us that "dilution is not the solution to pollution."

Principle nine states that remedial actions which dilute a problem or disperse it better are not acceptable unless they also incorporate actions which reduce at source the amount of pollution entering the environment.

Principle ten - "there should be zero discharge of persistent toxic chemicals" - is also a RAP goal, and has been touched upon in Chapter 2. It implies that the RAP should be working towards the goal of zero discharge. To test whether this principle is being followed, one could examine whether a particular remedial option will reduce the loading of persistent toxic chemicals into the environment. One can also test whether the Remedial Action Plan itself fulfils the principle.

Principle eleven suggests that research which supports the RAP principles should become part of the RAP itself. It also adds the caveat that lack of knowledge, (that is, the need for more research) must not be an excuse for inaction. This is an important point, given our inability to totally comprehend ecological systems. In most cases, says the principle, we know enough now to act. If additional information is needed, it should be collected as the cleanup occurs, and the results should be used for future decision-making.

Principle twelve states that remedial actions which are consistent with the RAP goals and principles should proceed if possible while the RAP is being developed. In short, where people agree that a remedial action is a good one, implementation should not be held up until the entire Remedial Action Plan is finalized. In fact, since the start of the RAP in 1986, many remedial actions have been initiated and these are mentioned in Chapter 4.

To deal with the entire spectrum of problems facing the waterfront and watersheds, principle thirteen states that the RAP must go beyond mere "remediation" of existing problems to include "preservation, conservation, rehabilitation and prevention." Most importantly, the Plan must consider how to prevent problems from recurring, for there is no point in cleaning up bottom sediments, if we continue to pour pollutants into our waters. The principle recognizes the need to rehabilitate (or restore to health) degraded wetlands, fisheries, creeks and rivers. The Plan must also consider the preservation of important natural areas, and the conservation of natural resources.

Principle fourteen states that "RAP goals and applicable remedial actions should be integrated into land use planning and construction approvals." This reflects the crucial need to bring together land use and environmental planning to ensure that implementation occurs. This principle is an important one to consider after remedial actions have been selected and the RAP committees are facing the question: How can we make sure that this Plan will be followed and not just sit on a shelf somewhere? The integration of the RAP and land use planning will also help to prevent future problems from occurring.

Principle fifteen also recognizes the need to ensure that implementation of the finished RAP takes place. Implementation of the finished Plan will require the coordinated efforts of many government and non-government bodies. However, this principle states that each remedial action "should be led and

coordinated by the appropriate and clearly defined and mandated party." To ensure accountability, one party must be given the responsibility of carrying out each remedial action. It also recognizes that some parties may be more appropriate to carry out particular tasks than others. As an example, if a remedial action involves alterations to a sewage treatment plant, then Metro Toronto (who owns and operates the plant), would be a better choice to take the lead in coordinating action than would the Ministry of the Environment.

Principle sixteen recognizes the importance of monitoring the progress of the RAP. It states that an "integrated and coordinated program of environmental monitoring" is necessary to achieve this end, as is the reporting of progress to the public. Monitoring allows one to evaluate the effectiveness of remedial actions, measure if progress is being made and determine if goals are being reached. Reporting to the public ensures accountability to taxpayers and other parties in the RAP process.

OPTIONS FOR REMEDIATION

A significant amount of work has already been carried out to identify possible options for remediating the environmental problems on the waterfront and watersheds in the RAP area. In April 1990, the *Draft Discussion Paper on Remedial Options* was released. This inch-thick technical document provided detailed information on a host of remedial options. A review of the document by the Technical and Public Advisory Committees subsequently identified a number of further options to be considered. To date, over 100 separate remedial options have been listed. While space does not permit an exhaustive description of all the options, this section attempts to give an overview of them. More information on remedial options can be found in Appendix C.

The remedial options can be categorized in many ways. In terms of what they achieve, the options include measures to:

- continue enforcement of laws and development of regulations;
- improve the collection and treatment of sewage;
- eliminate illegal storm sewer connections;
- reduce the inputs of toxics from households, industries and farms;
- reduce soil erosion;
- reduce the amount of stormwater collected and the amount of contaminants in it;
- reduce the rate at which stormwater is discharged into waterbodies;
- clean up contaminated sediments;
- conduct research which is needed;
- improve wildlife habitat; and
- improve public awareness about water issues.

In terms of the time required to implement, some of the options can be considered *short-term, some medium, and some long-term*. An example of an option which could be implemented in a relatively short-term is the improved cleaning of catchbasins. Catchbasins lie beneath storm sewer grates and collect dirt and pollutants from roads when rain falls or snow melts. Most municipalities clean out their catchbasins once a year. Increasing the frequency of cleaning would allow more dirt and pollutants to be trapped and removed, thereby reducing to some degree the pollution from storm sewers.

An example of an option which could be implemented over the medium-term is the option of improving programs to dispose of household hazardous wastes. The development of a comprehensive program to cover the entire RAP area would require a coordinated approach involving promotion, education about alternatives, and the provision of collection systems at depots or at the curb.

One of the remedial options which would take a long time to implement - perhaps as long as 20 years - would be measures to reduce the occurrence of combined sewer overflows into the Don and Humber Rivers and onto the waterfront to once a year. In part this would involve significant alterations to sewage systems, including expansions to two sewage treatment plants, and expansion of the capacity of the sewage system itself. This expansion of sewer system capacity would be used to hold combined sewage during rainfalls; it would be treated afterwards at the enlarged sewage treatment plants.

The remedial options which have been identified include some which can best be described "**end-of-pipe**" and others which involve "**control-at-source**." One control-at-source option is to find and disconnect toilets (usually in basement apartments) which have been illegally hooked up to storm sewers, instead of sanitary sewers. This would reduce the loading of bacteria to the Don, the Humber and Lake Ontario. Another control-at-source option is to reduce pollution from farms through the use of soil conservation and runoff control measures. This would reduce the loading of sediment and contaminants from farms in wet weather.

Sewage treatment plants themselves would have to be considered "end-of-pipe" solutions to the problem of how to deal with human wastes. Although there may be different ways of building these plants, there is at present no substitute for them in urbanized areas. What we can do, however, is to use sewage treatment plants more effectively. Through water conservation programs (which are control-at-source options), flows to sewage treatment plants can be reduced. This means an effective "increase" in plant capacity and improved efficiency in some plant operations.

Another "end-of-pipe" or "dilution" option was the proposal to build a diffuser at Centre Island. On the beach on the south side of Centre Island, water quality is adversely affected by the dirty water which comes down the Don River, moves out through the Eastern Gap, and is carried by currents westward. The diffuser would be used to force lake water at high velocity through holes in a pipe, and so direct the plume of dirty Don River water away from the beach. This is a classic dilution approach which disperses pollution better but does not reduce inputs at all. Although it is technically feasible, both the Public and Technical Advisory Committees have recommended against further consideration of this option.

Somewhere in between control-at-source at one end of the spectrum and end-of-pipe at the other (half-way down the pipe, if you will) lie options such as the use of detention ponds to improve the quality of stormwater. Such ponds would be constructed to hold stormwater after rain falls. This, by itself, could control one aspect of the problem - the sheer volume of water which runs down swollen rivers at such times, eroding banks and carrying sediment downstream. With a detention pond, the collected stormwater would be released in a controlled manner. Using a pond would also improve the quality of the effluent because particles and

some of the contaminants in the stormwater would settle to the bottom of the pond while the water is held. These contaminants, however, would not go away, but would remain in the sediments and may require cleaning out periodically. This example illustrates well the fact that the remedial options are not always tidy little packages which can be easily categorized or evaluated. It reinforces the need to use an ecosystem approach - to understand as best as one can the implications of implementing options.

The remedial options identified deal not only with remediation, but also prevention, rehabilitation, preservation and conservation. Any of the "control-at-source" options can be thought of as preventive measures. These include programs to reduce the loading of chemicals from households and industry, programs to reduce the amount of stormwater generated, programs to trace and disconnect illegal connections to storm sewers, pet control bylaws and others.

Rehabilitation options have also been identified. These include options to restore streams and fish habitat in the watersheds and along the waterfront. Much can be achieved through physical improvements such as planting trees along streams and rivers to control erosion and provide shade and stabilizing stream banks. Fish habitat can be further improved through the creation of marshes, deep pools and shallow gravel beds in streams and rivers.

The preservation of valuable natural and semi-natural areas is touched upon in some of the remedial options which have been identified. The Rouge River Watershed Management Strategy identifies the need for municipal zoning to protect areas with significant plant and animal communities. Metro Toronto and Region Conservation Authority's Greenspace Plan outlines the Authority's intention to acquire key parcels of land in the Oak Ridges Moraine, along river valleys, and along the waterfront. Certainly, protecting water quality is one reason to preserve natural areas, but there are many others. Such areas are vital for terrestrial wildlife habitat, the protection of animal and plant communities and diversity, recreation for humans, and others. Comprehensive strategies for preserving natural areas have recently been considered in Ron Kanter's Greenlands Strategy and in the work of the Crombie Commission, (the Royal Commission on the Future of the Toronto Waterfront).

The Public Advisory Committee has suggested that a program to conserve water is an appropriate remedial option to consider. A comprehensive water conservation program would involve such elements as public education, water metering, and full-cost pricing of water. Water conservation is perhaps better thought of as wasting less water, or using it more efficiently. If less water is used, then less has to be treated afterwards at sewage treatment plants. The more effective the treatment of sewage, the less the impacts on the natural environment.

The notion of conservation can also be applied to stormwater. The traditional approach to stormwater management in an urban setting was to treat it as a waste to be drained and disposed of as quickly as possible. There is a growing understanding today of the need to view stormwater - it is, after all, water - as a resource to be managed and used to benefit society. If viewed like this, stormwater can be used to water parks, gardens and yards. If stormwater is stored in detention ponds, wildlife habitat can be created. If allowed to soak into the

ground, stormwater will recharge groundwater. If not viewed as a resource, then managing stormwater means forever building more pipes for collection in order to minimize flooding.

Rough costs have been calculated for most of the remedial options which have been identified to date. As might be expected, the cost of options varies widely. A number of possible programs have been identified which aim to increase public awareness and involvement in environmental programs on the waterfront and watersheds. Typically, these programs cost under $100,000 a year. At the other end of the spectrum lie the more expensive options involving large engineering solutions. Among these are options to reduce the impacts of combined sewer overflows. It is estimated that measures to reduce combined sewer overflows by detention would cost (in 1988 dollars) about $390 million over 20 years. To then treat this combined sewage would require expansions of the Main and Humber Sewage Treatment Plants which would cost an additional $480 million. To put these figures into perspective, it is useful to also consider the costs of not acting, although these are often difficult to quantify.

The remedial options which have been identified are targeted at government, industry, agriculture, non-governmental organizations, and individuals alike. Governments include municipal, regional, provincial and federal agencies. The province, through the Ministry of the Environment, will play a major role in coordinating implementation of the overall plan. As a regulator, the Ministry also has a role to play with the setting of new guidelines for lakefilling, sediment quality, and contaminant levels in aquatic life. The federal government, through Environment Canada, is conducting research into how to treat contaminated bottom sediments. Metro Toronto would be the lead agency for options dealing with sewage treatment plants, and local municipalities would deal with options such as cleaning of catchbasins or tracing illegal toilet hook ups.

Industrial sources are addressed through a number of options. One of these is to improve "best management practices" - strategies to reduce the possibility of spills or accidents occurring in plants. Reductions in the amount of chemicals entering our waters will come through better control of industrial sewer use under the provincial MISA program. Options involving agriculture include measures to reduce erosion and chemical pollution.

Non-governmental organizations already play a role in attempts to restore water quality on the waterfront and watersheds in the RAP area. Reflecting this, one RAP option is to encourage and financially assist such groups. One such citizens' group is the Black Creek Project which was formed in 1982 to carry out improvements to the Black Creek which drains into the Humber River. Among the tasks carried out or proposed by the group is the creation of a wetland in the Town of Vaughan, tree planting along the creek, erosion control, the building of recreational trails, and the improvement of fish habitat.

There are many RAP options which are directed towards individuals. These include programs to collect household hazardous waste and programs to promote water conservation in the home. Also identified are options which aim to increase public awareness of environmental problems, change behaviour patterns and encourage involvement in preventive or clean up activities.

TESTING OPTIONS AGAINST THE PRINCIPLES

In order to select which of the more than 100 remedial options might be best for the Metro Toronto and Region Remedial Action Plan, we need some way of evaluating and comparing them. As has already been pointed out, we propose to do this by evaluating options against the RAP principles which have been developed. In this section we demonstrate how this might be done.

As examples, we have chosen to evaluate two of the many options which could be used to reduce the impacts of urban stormwater. We are not choosing one or the other in this exercise, but merely evaluating them against a common yardstick - the RAP principles. One needs to evaluate all the options before making choices.

To recap the problem, stormwater poses a challenge both in terms of the quantity produced and its quality. In a city, huge volumes of stormwater are created during rain storms. Most of the rain which falls on an impervious surface - roofs, roads, parking lots - is collected and transported through storm sewers which discharge into rivers and streams or directly onto the waterfront. The stormwater which surges down rivers and streams causes erosion along banks. Along with the stormwater comes significant amounts of bacteria, nutrients, oil and grease, heavy metals and toxic chemicals which cause a deterioration in water quality in rivers and along the waterfront.

The first option we have selected to run through the RAP principles is the option of **encouraging homeowners to re-direct downspouts (drainpipes) from sewers** and send rainwater instead to lawns and gardens. This is a "low-tech" option where the action can be carried out by an ordinary citizen. This option will reduce the volume of stormwater which must be collected by the municipality, and therefore reduces the erosion of rivers and streams. It should also improve the quality of stormwater which is eventually

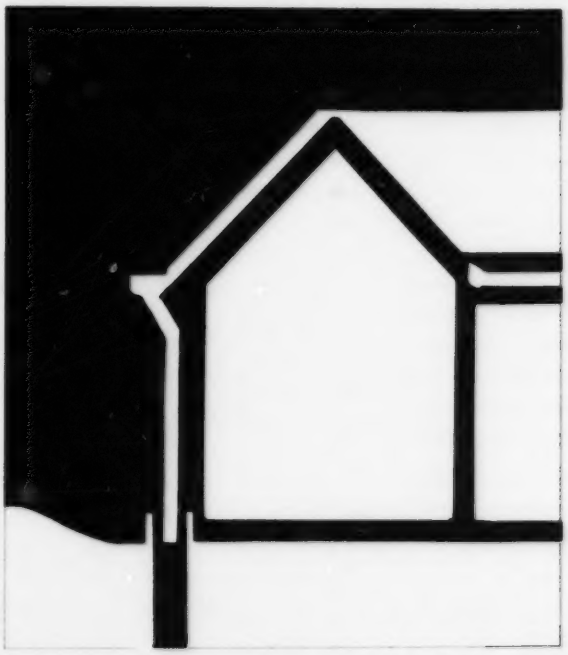

Figure 19a: Downspouts can be connected to storm or combined sewers

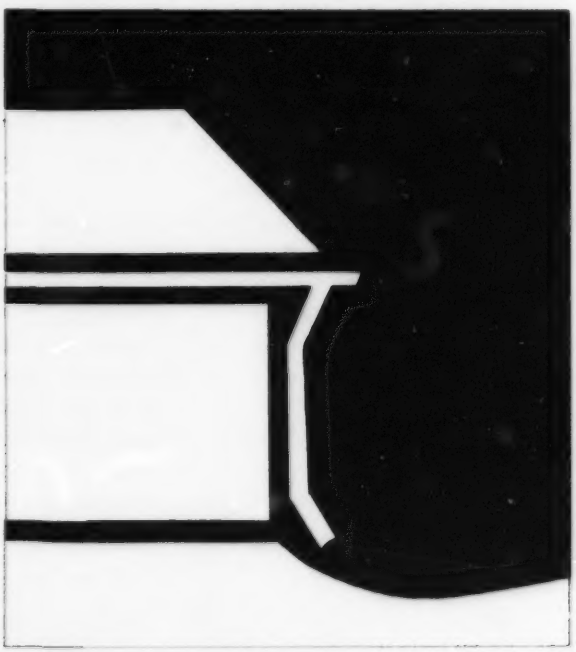

Figure 19b: Disconnecting spouts reduces amount of water entering system

discharged. In areas which are still serviced by combined sewers, this option will reduce the flow to the sewage treatment plant. Finally, allowing the stormwater to soak into the ground also allows the recharge of groundwater.

The second option is an engineering solution - to **build detention ponds to hold stormwater** during rainstorms. This solution controls the rate at which stormwater is released into rivers and streams, and thus will reduce erosion.

Because settling occurs in the pond, the quality of the discharged stormwater will be improved.

In the example below, the RAP principles are paraphrased. The full set of principles can be found on page 27. In addition to the 16 principles developed, two additional measures have been used in the evaluation: technical feasibility of the option, and cost-effectiveness.

1. Water should be conserved, protected and restored:
Both options embrace the notion that stormwater is a resource to be conserved.

Disconnecting downspouts allows stormwater to be used for watering gardens and yards and helps to recharge groundwater. If a detention pond is used for wildlife habitat, then water is being conserved to support wildlife. Both options are directed at improving (or restoring) water quality.

2. An ecosystem approach should be used:
Using the ecosystem approach means that there are questions which need to be answered about both these options. For disconnecting downspouts: Are

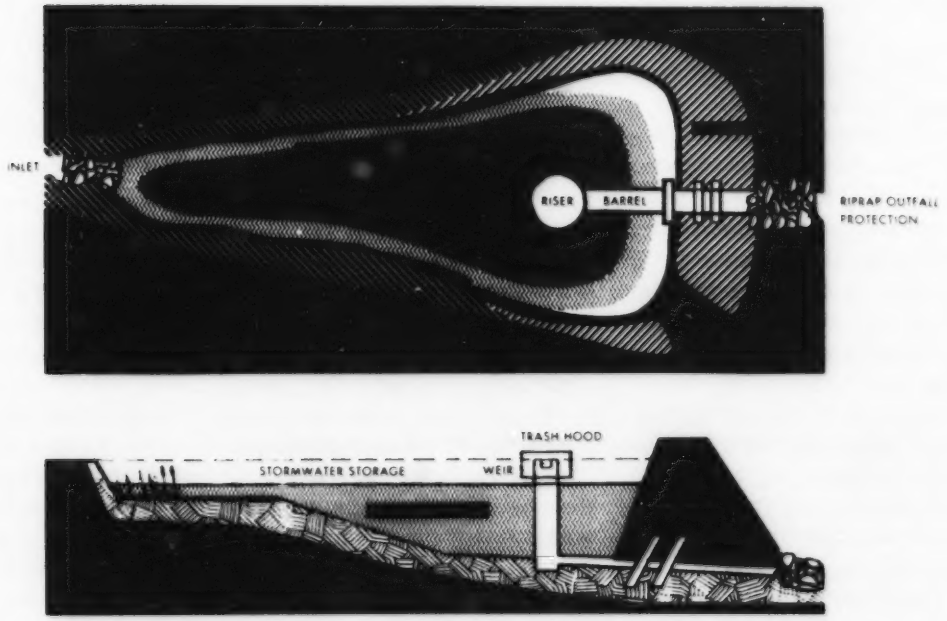

Figure 20: A stormwater pond is one option for controlling the quality and quantity of stormwater

there areas of the city where this is not appropriate because of housing density or soil type? (We don't want to improve water quality at the expense of flooding some people's basements.) What are the positive and negative effects of implementing this option?

Questions regarding the use of detention ponds: What will be the quality of the bottom sediment in the ponds? (Will periodic cleaning out be required? If so, where will the sediments go and what will be their effect on the environment?) What impacts will the use of detention ponds have on loss of parkland, safety, impediments to fish movement? What are the benefits in terms of creation of wildlife habitat and public awareness?

3. Addressing RAP goals:
Both options address RAP goals 2 (fishable, swimmable, drinkable) and 3a (quality of stormwater). In addition, the first option addresses goal 4 - the costs of remediation (disconnecting downspouts) would be borne by the homeowner who is the source of the problem, (that is, whose roof collects the rain in the first place).

4. Stakeholder involvement in decision-making:
This principle is an overarching one, and is not useful when evaluating these options. It must, however, be fulfilled by the option selection process itself. It is important to note in this regard that stakeholders can be very different for different options.

5. Individual responsibility:
The option to disconnect downspouts fulfils this principle. Successful implementation requires individual homeowners to take action in order to reduce their impact on the environment. The option of building detention ponds does not fulfil this principle.

6. Public awareness and education:
Informing the public about the problems would be an integral part of an option to encourage homeowners to disconnect downspouts. This would help people understand the connections between their actions and consequent impacts on the environment.

Public awareness and education would likely be needed in order to site a detention pond, but thereafter it need not be done. However, it can serve an educational function, especially if the pond is used for wildlife habitat, with the addition of signs and interpretive displays.

7. Voluntary and legislated action:
As envisaged, the option of disconnecting downspouts would involve voluntary action. It could, however, also be legislated through a municipal bylaw. Certainly for new houses, it would be relatively easy to prohibit rain water from downspouts from being sent to storm sewers.

For municipalities (and perhaps regions) the use of detention ponds would be a voluntary solution to the problem of stormwater. Such actions might be encouraged, however, if objectives were set for stormwater quality as part of Master Drainage Plans.

8. Source Control:
The option of disconnecting downspouts is control at source for quantity. The rain water which falls on the roof would be directed into the garden, and would therefore never enter the "system" as stormwater which would have to be managed. However this option is not source control of the pollutants which are picked up by rain water - it merely moves them around. Pollutants washed off the roof would be deposited in the garden instead of in the storm sewer.

The use of detention ponds for stormwater is not a source control option. It does nothing to reduce at source the volume of stormwater or the amount of pollutants picked up by it. Ponds detain the water to control its rate of release. Some of the pollutants will settle out in the bottom sediments of the pond and so the quality of the stormwater, when discharged, will be improved.

9. Dilution and dispersion:
As discussed in the previous point, disconnecting downspouts controls at source the quantity of stormwater generated, but not the quality. To fulfil this principle, the option of disconnecting downspouts would have to be complemented with other actions which would reduce the amount of pollutants which fall from the air.

To fulfil this option, the building of detention ponds would have to be complemented with measures to reduce the amount of stormwater generated (quantity) and measures to reduce the amount of pollutants falling onto the ground (quality).

10. Zero discharge:
Because neither of these options reduce at source the loading of persistent toxic chemicals, neither fulfil this principle.

11. Research to support the RAP:
There may be research elements to both the options which can take place concurrently with implementation which would support the RAP. For disconnecting downspouts, research could be done into public attitudes, costs to the householder, innovative methods, and other aspects. For detention ponds, research could include such areas as the quality of sediment at the bottom of the pond, effluent quality, wetland design and habitat effectiveness.

12. Ongoing action:
If both options are deemed by the RAP stakeholders to be useful parts of the RAP, implementation could proceed before the Remedial Action Plan is finalized.

13. Preservation, conservation, rehabilitation and prevention:
Because both options affect the quantity of stormwater which would rush down streams and rivers, both help to prevent erosion of banks from occurring.

14. Integration with land use planning:
In some parts of the RAP area, for new development, downspouts are not allowed to be connected to storm sewers. For existing housing, if the disconnection of downspouts were enshrined as a municipal bylaw, then integration with land use planning would start. Similarly, integration with land use planning would start if the use of detention ponds to improve stormwater quality was made a requirement for new development or re-development.

15. Responsible agent:
The responsible agent to lead a program to disconnect downspouts from storm sewers would logically be the local municipality, as storm sewers are a local responsibility. The local municipality may also be the most appropriate body for building detention ponds except for the fact that, while they have copious experience dealing with stormwater quantity management, local municipalities are new to the management of stormwater quality. For stormwater pond projects, then, it may make more sense to have a region as the lead agency. What is most important is to have one clearly defined body in charge.

16. Monitoring and reporting:
Ongoing monitoring would be required of both options. For the disconnection of downspouts, it would be useful to keep track of how many houses have been disconnected, the reduction of volume in stormwater obtained, and public attitudes towards the program. For stormwater detention pond projects, monitoring should be rigorous, and should include the quality of incoming and outgoing water, sediment quality and the volume accumulated, and effects on wildlife.

Technical feasibility:
There are questions about the participation rate which could be achieved by a voluntary program to encourage homeowners to disconnect downspouts from sewers. So too, are there questions about the size of yard and type of soil which would be needed to absorb rainwater. One might wish to test these with a pilot project involving a relatively small number of houses before moving to an area-wide program. Questions also remain about the effectiveness of detention ponds. Reports in the literature show a great variability in performance, and design criteria have been poorly documented.

Cost effectiveness of options:
Cost-effectiveness may be defined as the amount of improvement achieved (say, in water quality) for the amount of money spent. This will of course vary from option to option. Generally, it can be said that cost-effectiveness is a notoriously difficult thing to determine because of the complex natural and man-made systems involved. At the time of writing, cost effectiveness was not available for either of the options.

CONCLUSIONS

Having gone through the exercise of evaluating two options against the RAP principles which have been developed, the principles appear to provide a useful framework for testing remedial options. The framework will allow identification of which options fulfil the principles and which don't. This may allow rejection of some options out-of-hand. After evaluation, the remaining remedial options can be compared and prioritized using such measures as how well they meet the RAP principles, their cost-effectiveness, total cost, and the time required to implement.

The proposed approach for selecting remedial options can be summed up as follows:

- it provides a yardstick against which remedial options can be evaluated;
- it ensures that the Remedial Action Plan will meet the RAP goals;
- it requires a thorough understanding of the implications of the proposed actions for all facets of the environment;
- it puts a priority on strategies, programs and plans which reduce pollution at source;
- it ensures that implementation will occur through stakeholder involvement and identification of lead agencies to coordinate actions;
- it ensures that remedial options involve individuals as well as institutions, municipalities and industries;
- it allows appropriate remedial actions to start before the Plan itself is finished; and
- it ensures that the effectiveness of remedial options is being monitored and reported.

The options which are finally selected will form the Remedial Action Plan for Metro Toronto and Region. How this will be done is covered in the next chapter.

This chapter first reviews some of the ongoing remedial actions which are taking place in the RAP area. It then goes on to outline the next steps in the RAP process - where we go from here. The chapter finishes with a brief section describing some of the ways in which you can get involved in cleaning up the waters in the Metro Toronto RAP area.

Figure 21: The Black Creek Project rehabilitates streambanks in the Metro RAP area

ONGOING REMEDIAL ACTIONS

Those involved in the development of the Metro Toronto Remedial Action Plan (and many members of the public) feel the need to move forward with the RAP process - the process of cleaning up Metro's waterfront and watersheds. The development of the Plan itself, however, has been underway since 1986. The conducting of research, the collection and analysis of data, the setting of goals and principles, the identification of remedial options - all these necessary activities have taken time. The selection of remedial options remains to be done, as does the development and implementation of the final RAP. At the very earliest, it is expected that it will take until late 1992 to prepare the draft Remedial Action Plan.

And in the meantime, human activities are still putting stress on the ecosystem we call home. Combined sewers are still overflowing, contaminated stormwater is still gushing into rivers, and excessive erosion is still occurring in the streams and rivers in the RAP area. The RAP principles affirm the need for cleanup actions to start, where possible, before the final RAP is in place.

In one sense, cleanup of the waters in the Metro Toronto area has been ongoing since the first sewage treatment plant was built in 1910. Much valuable work was done in the 1980s under the Toronto Area Watershed Management Study. This work was the foundation for the RAP and was responsible for identifying sources of pollution.

When four levels of government came together in 1986 to begin to develop the RAP, cleanup activities did not grind to a halt. In fact, a number of significant undertakings have taken place since 1986. Many of these have been carried out under the Metro Toronto Waterfront

Water Quality Improvement Program (WWQIP) which is jointly funded by Metro Toronto and the MOE. Between 1984 and 1989, $52.1 million was spent on WWQIP projects.

Under the WWQIP, many studies were done in order to better understand the aquatic environment - exactly what is going on now - and how various remedial options might improve matters. These sorts of studies have been vital to the identification of remedial options for the RAP. Remedial measures undertaken under the WWQIP include physical improvements to and cleanup of beaches, repairs to sewers and separation of storm and sanitary sewers. In 1990, every municipality in Metro except for East York carried out remedial work on priority storm sewers - those whose outfalls discharge the highest levels of bacteria and chemicals into local streams and rivers. This abatement work continued in 1991.

Under the WWQIP, a detention tank in the Eastern Beaches for stormwater and combined sewer overflows was designed and constructed by the City of Toronto. This is helping to improve the chemical and bacteriological water quality at the Eastern Beaches, and ongoing monitoring of the tank's effectiveness will help determine if two more detention tanks should be built.

Studies have also commenced on the feasibility of building a stormwater detention tank in High Park. The purpose of such a tank would be to improve water quality at Toronto's Western Beaches.

With funding from the WWQIP, the City of York carried out a program in which home owners are asked to participate in a voluntary program to disconnect downspouts from sewers. Where homeowners agree and conditions are suitable, the City carries out the disconnection.

Through the WWQIP, the design is underway for a stormwater detention pond on Emery Creek which empties into the Humber River. This would be the first "wet" pond dedicated to improving the quality of stormwater discharges.

Other local initiatives are also taking place. Metro Toronto is developing a water conservation strategy with the aim of increasing the efficiency of its water treatment and sewage treatment systems. An innovative program run jointly by the Canadian Wildlife Service and the Metropolitan Toronto and Region Conservation Authority provides alternative nesting habitat for common terns at the Leslie Street Spit. This has been done through the provision of four rafts on which the terns can nest, safe from encroachment by gulls.

Since the early 80s, broader basin-wide or province-wide initiatives have also continued. Many of these will help to improve water quality on the Metro Toronto waterfront and in the watersheds. Ontario's Municipal-Industrial Strategy for Abatement (better known as MISA) is one such program. When complete, its primary effect in the Metro RAP area will be to set standards for industrial sewer users based on "best available technology,"and to set tougher standards for sewage treatment plants.

Ontario is also developing its Clean Air Program (or CAP) which will set tough new standards for emissions into air. The Lake Ontario Toxics Management Plan is being developed by the US and Canadian governments with the long-term aim of virtually eliminating inputs of persistent toxic chemicals to the lake.

While not strictly "remedial," other important initiatives are taking place in standard setting and research. Contaminated sediments are a problem in

almost all of the 43 Areas of Concern named by the International Joint Commission. We have already seen how contaminants can continue to leach out of sediments for decades. But a number of questions have not been answered yet about sediments. For example, no one really knows what concentrations of contaminants in sediments should trigger cleanup. And no consensus exists on the best method of dealing with highly contaminated sediments. Should they be left in place? Should they be dredged and treated? If so, how?

To answer the first question, the Ontario Ministry of the Environment is developing comprehensive sediment quality guidelines which will give guidance on when sediments need to be remediated. Environment Canada is spearheading research into how sediments can best be cleaned up. The outcomes of both these initiatives will help guide the Metro Toronto Remedial Action Plan.

THE RAP PROCESS

The RAP process, like all good planning processes, is dynamic and interactive. It attempts to include all stakeholders in decision-making. The theory behind this is that through joint decision-making, better decisions are made. Involving all parties in a plan's development also improves the chances of successful implementation - because people have "bought into" the process, they will work to see it through to the end.

The public, through the Public Advisory Committee, has been involved in setting the direction for the RAP, and in commenting on documents produced. The five regions and 17 municipalities in the RAP area are involved through the Technical Advisory Committee. At key decision-making points, consultation opportunities have been set up to receive input from the general public, and the process has been open to public input from its inception.

Because of the interactive nature of the process used - the feedback loops from various interests - the planning process can, and has changed to address the concerns and priorities of the people developing it. The Metro Toronto and Region RAP which was envisioned in 1986 is likely very different than the one which exists today; the finished product will likely have changed still further.

Broadly speaking, though, we can map out the route which will be taken. There are three essential steps remaining in the RAP:

1. First, we need public input on the direction in which we are proceeding. A formal opportunity for public consultation will be held in the fall of 1991, but we are always open to input from the public at any time. We would like to hear from you! (See the next section, **How You Can be Involved**.)

2. After incorporating the results of our public consultation, we can move ahead to select remedial options to become part of the Remedial Action Plan.

The process of selecting remedial options will involve the setting of priorities and making decisions about timing, (which actions will take place at what time and in what order). The selection process will be carried out by the RAP team in tandem with the Public, Technical and Scientific Advisory Committees.

3. After selection of the remedial options, an implementation plan must be developed. As envisaged, the implementation plan would include:

- the designation of a lead agency or body for each selected remedial option;
- identification of roles of other partners in the implementation;
- the commitment of funding for each selected option;
- scheduling of remedial options; and
- an outline of a process of periodic monitoring, evaluation and reporting.

At the end of step three, a draft Remedial Action Plan for Metro Toronto will be ready. The current target is to have this done by late 1992. It must then be reviewed by the public and the agencies involved to get their endorsement. Once input on the draft Plan is received and incorporated, the final Remedial Action Plan can then be prepared. It is the final Remedial Action Plan which will be implemented.

In the meantime, ongoing remedial projects, some of which have been described will continue, and new remedial actions may be brought forward before the final RAP is ready. This will continue the cleanup process, and help to raise public awareness. Public awareness of the need for cleanup, and public support for remedial actions is absolutely vital to restoring our waters. The next section of this report is an invitation to you as a member of the public.

HOW YOU CAN BE INVOLVED

We have said many times that the environmental problems facing the waterfront and watersheds in Metro Toronto are complex. So too, are the solutions. Cleaning up the waterfront is a task which must be shared by everyone - public and private sector, government, non-governmental groups and individuals. There are many ways in which you can help clean up Toronto's creeks, rivers and waterfront. Here are some of them:

1. *Get involved in the Metro Toronto and Region RAP.* Phone us and we'll put you on the mailing list and keep you informed as events unfold. In particular, we'll inform you about public consultation opportunities as they arise.

Now that you've read Strategies, let us know what you think about the direction we are heading by writing us a letter. Here are some of the questions to which we'd like answers:

- Are you in favour of cleaning up the waterfront and watersheds in the Metro RAP area?
- Do you agree with the RAP principles which have been developed?
- If not, why not? Which ones do you disagree with?
- Should we move forward to select remedial options using these principles as a yardstick?
- Would you like a speaker from the Metro Toronto and Region RAP to talk to your group or organization?
- Is your group or organization involved in any activities in which RAP could play a part?

Write us at:
Metro Toronto and Region RAP Coordinator,
Ontario Ministry of the Environment,
4th floor, 7 Overlea Blvd.,
Toronto, Ontario
M4H 1A8
Tel / 323-4678.

2. *Join a Cleanup Initiative.* Over the last couple of years, a number of grassroots groups have sprung up which are dedicated to cleaning up the aquatic environment in the Metro RAP area. These include the groups listed below. If you like the idea of planting trees, building

trails, cleaning up river banks, or wading around creeks in rubber boots to pull out old tires, you may want to consider joining one of these groups. Here are contact names:

The Black Creek Project,
PO Box 324, Station A,
Downsview, Ontario
M3M 3A6
Tel / 969-9637

Action to Restore a Clean Humber,
c/o Mr. L. Martin,
21 Taysham Crescent,
Etobicoke, Ontario
M9V 1X1
Tel / 741-5346

Save the Rouge Valley System,
PO Box 88005,
2975 Kingston Road East,
Scarborough, Ontario
M1N 3W
Tel / 287-1776

Task Force to Bring Back the Don,
20th Floor, East Tower,
Toronto City Hall,
Toronto, Ontario
M5H 2N2
Tel / 392-1255

3. ***Develop Your Own "Remedial Action Plan."*** These days it seems like more and more people are getting involved in setting up recycling plans for home, school, office or industry. The same sort of thing could be done for improving water quality - a remedial action plan for the home or office. Here are some resources which might be useful for doing this:

Water: No Time to Waste. An easy-to-read booklet developed by Environment Canada as a consumer's guide to water conservation. The booklet teaches about the water cycle, and provides information about how individuals can play a role in improving the quality and protecting the quantity of our water resources. Available from:

Canada Communications Group Publishing, Ottawa, Canada
K1A 0S9

Beyond the Blue Box. A guide to waste reduction and recycling published by Metro Toronto. The guide includes alternatives to some of the household hazardous products such as drain cleaners and chlorine bleach which get poured down sinks. For more information on Metro Toronto's Household Hazardous Waste Program contact:

Metro Toronto Works Department,
Solid Waste Management Division,
439 University Avenue,
20th floor,
Toronto, Ontario
M5G 1Y8
Tel / 392-4330

The Canadian Green Consumer Guide. A consumer guide for the 90s about how to make intelligent (and environmentally good) choices in the marketplace. Includes sections on gardening, household hazardous products, water efficiency and more. Available at bookstores or from:

The Pollution Probe Foundation,
12 Madison Avenue,
Toronto, Ontario
M5R 2S1
Tel / 926-1907

Many environmental groups have magazines, newsletters, videos and other resources. A complete listing of environmental groups is available in the Environmental Resource Book which is available from:

Ontario Environment Network,
Suite 201c
2 Quebec St.
Guelph, Ontario
N1H 2T3
Tel (519) 837-2565

Also, you may want to check what resources are available at your local municipality. Check the blue pages in your phone book.

aquifer
a porous, water-bearing rock formation

bioconcentration
a process whereby an organism accumulates higher levels of contaminants than are found in its surrounding environment or food

combined sewage
a mixture of sanitary (human waste) and stormwater run-off

combined sewer
an old-style sewer in which one pipe carries both sanitary sewage and stormwater run-off

combined sewer overflow
a discharge of combined sewage to a water body; caused when the carrying capacity of a combined sewer is exceeded during heavy rain falls

DDT
a widely-used, very persistent pesticide used extensively in agriculture in the 1940s and 1950s, most uses of which were phased out in 1969, DDT was banned for all uses in Canada in 1989; DDE, a breakdown product of DDT, has been identified as the cause of eggshell thinning in many birds

ecosystem
the interacting complex of living organisms and their non-living environment; air, land, water and living organisms (including humans) and the interactions between them

effluent
waste waters discharged from facilities to sewers or water bodies

embayment
a semi-protected cove or bay providing relatively sheltered waters

groundwater
water which lies and flows under the ground

headwaters
the small streams that are the sources of a river

IJC
International Joint Commission: a binational organization established in 1909 by the Boundary Waters Treaty; through the IJC, Canada and the US cooperatively resolve problems along their common border (including water and air pollution, lake levels, and other issues of mutual concern)

indigeneous
occurring naturally in a region

invasive
having a tendency to invade and proliferate, especially with regard to plants

invertebrates
animals with no backbone

lakefilling
the act of depositing rock, soil and other materials in a water body to create a land mass

mirex
a long-lived pesticide which has been found in significant quantities in Lake Ontario; it causes reproductive problems and cancer; although never used in the Great Lakes Basin for agriculture there were industrial releases into the Niagara and Oswego rivers, all uses of mirex in Canada were banned in 1978

MISA
Municipal-Industrial Strategy for Abatement — a program being developed by the Ontario government to control industrial and municipal discharges to water; the principal goal of the program is the virtual elimination of toxics discharged from point sources into Ontario's water bodies

MOE
Ontario Ministry of the Environment

non-point source
a source of pollution in which pollutants are discharged over a wide area, or are from a number of small inputs

Oak Ridges Moraine
a glacial deposit of sand and gravel which forms the headwaters and the divide for streams flowing southwards to Lake Ontario and northwards to Lake Simcoe and Georgian Bay; the northern boundary of the Metro Toronto and Region RAP area is formed by the Oak Ridges Moraine

outfall
the end of a pipe where effluents are discharged into water

PCBs
polychlorinated biphenyls - a family of stable, long-lived chemicals used for a broad range of industrial uses including insulating fluids in transformers; they bioconcentrate in animal tissues, cause reproductive failures, and are a suspected human carcinogen; they were banned in 1980, except for continued use in electrical equipment

point source
a source of pollution that is distinct and identifiable, such as an outfall pipe from an industrial plant

RAP
Remedial Action Plan - a plan to be developed, with citizen involvement to restore and protect water quality; RAPs are being developed at 43 sites on the Great Lakes

recharge
to add water to an aquifer

remediation
an action which cures or relieves a problem

sanitary sewage
human wastes usually carried off by sanitary sewers

storm sewer
a sewer for the collection and carrying of stormwater run-off

stormwater
water from rain storms

watershed
the area of land drained by a river and its tributaries

1. Toronto's waterfront and watersheds should be a diverse, healthy, integrated ecosystem. They should be managed using an ecosystem approach in order to restore beneficial uses of our aquatic resources. An ecosystem approach is a comprehensive and systematic consideration of the interacting components of air, land, water and living organisms, including humans.

2. Toronto's watersheds and nearshore zone should provide citizens with fishable, swimmable, drinkable and aesthetically pleasing water and aquatic habitats.

2a. Any fish species indigenous to the Toronto waterfront and its watersheds should be able to return to the region, to live and naturally reproduce here.

2b. Opportunities to sustain and create fish and wildlife habitat throughout the Toronto watershed should be pursued in parallel with water quality initiatives.

2c. Within the waterfront, watershed and headwaters, protection of the remaining wetlands should be a primary concern. A priority for any development or remedial measure should be, where possible, to avoid effects on existing wetlands, and where possible to provide increases in wetland habitat.

2d. People should be able to consume fish from the Toronto waterfront and its watersheds without any restrictions resulting from contaminants of human origin.

2e. People should be able to swim and engage in water sports in Lake Ontario and Toronto's watersheds without risk of disease or illness.

2f. Levels of potentially toxic chemicals in Toronto's drinking water should not exceed acceptable standards as determined by the best scientific methodology available and when no health standards have been established, should not be detectable by the best scientific methodology available.

2g. The aesthetic quality of the waterfront, river valleys, ravines, wetlands and waterbodies in the watersheds should be of sufficient quality to enhance passive and active recreational uses for all people.

2h. Opportunities should be provided for residents and visitors to study or observe a functioning, healthy ecosystem.

2i. People should be able to swim and engage in waters sports in Lake Ontario and Toronto's watersheds without encountering dangerous or hazardous materials.

3. Discharges to Toronto's waterfront and watersheds should not contain harmful micro-organisms or hazardous chemicals at levels which impair beneficial uses, inhibit biota or produce other adverse impacts on the ecosystem. There should be zero discharge of persistent toxic chemicals.

3a. The quality of stormwater discharged to receiving waters should be of sufficient quality so that it does not impair beneficial uses, inhibit indigenous biota or produce other adverse impacts on the ecosystem.

3b. The discharge of combined sewage to receiving waters should be virtually eliminated and any remaining discharge should be of sufficient quality so that it does not impair beneficial uses, inhibit indigenous biota or produce other adverse impacts on the ecosystem.

3c. The quality of effluent discharged to receiving waters from sewage treatment plants should be of sufficient quality so that it does not impair beneficial uses, inhibit indigenous biota or produce other adverse impacts on the ecosystem.

4. The costs associated with environmental controls and rehabilitation should be the responsibility of those who are the source of pollution. It is explicitly recognized in the Metro Toronto RAP area that much of the pollution is caused by individuals and the public, including industry and agriculture.

4a. Cost effectiveness analysis should be used in RAP development and implementation to prioritize resources for water quality improvement.

5. The public should have sufficient access to Toronto's waterfront and valley systems in order to make them a focus of public involvement, recreation, enjoyment and cultural activities.

6. The volume of in-place and transported sediments being deposited in Toronto's watersheds should be stabilized at near natural levels by controlling their release at the point of origin. These sediments should be free of persistent contaminants, and contain safe levels of non-persistent contaminants.

7. Lakefilling should not be permitted unless it can be demonstrated not to impair beneficial uses of aquatic ecosystems. All possible means of improving the environment as a result of each project should be explored as part of the planning process in any development.

8. The atmospheric deposition of potentially hazardous substances resulting from human activities in the Toronto area should have no adverse impacts on the ecosystem.

9. Opportunities should be created and resources identified for the Metro Toronto RAP, in the spirit of cooperation, to have input to plans in other areas, such as the Niagara River or the setting of lake water levels, which have significant impact on Toronto's water quality.

10. Navigation and recreational uses in the Toronto waterfront should be maintained. An ongoing dredging option should be available so long as it is carried out in an environmentally acceptable manner.

11. Public awareness activities and consultation should continue throughout the RAP implementation phase.

12. There should be a mechanism for regular review of the goals and the implementation of the remedial action plan.

RAP PARTICIPANTS

RAP TEAM

Chair: Mr. Jim Merritt
Ministry of the Environment

Dr. Jim Ashman
Ministry of the Environment
Mr. James Barker
Ministry of Natural Resources
Ms. Suzanne Barrett
Royal Commission on the Future of the Toronto Waterfront
Ms. Moyra Haney
PAC Representative
Mr. Karl Hemmerich
City of Toronto, Works Department
Mr. Steven Klose
Ministry of the Environment
Mr. John Maher
PAC Representative
Mr. Craig Mather
Metro Toronto and Region Conservation Authority
Mr. Michael Mansfield
City of Etobicoke, Works Department
Mr. Michael Price
City of Scarborough, Works Department
Dr. Harvey Shear
Environment Canada
Mr. Dan Taylor
PAC Representative
Mr. Michael Thorne
Metro Toronto, Works Department

PUBLIC ADVISORY COMMITTEE

Co-Chairs:
Ms. Moyra Haney,
Mr. Dan Taylor

Mr. Glen Atkinson
Agriculture Sector
Mr. Wilbert Bach
Agriculture Sector
Ms. Suzanne Barrett
Royal Commission on the Future of the Toronto Waterfront
Councillor Ila Bossons
Metro Toronto and Region Conservation Authority
Ms. Marilyn Cook
Municipal Sector
Mr. Jim Early
Agriculture Sector
Councillor Alex Faulkner
Municipal Sector
Mr. Christian Fisker
Recreation/Tourism Sector
Mr. Ed Fortune
Business/Industry Sector
Mr. Ed Fox
Community Groups/ Individuals Sector
Dr. Lino Grima
Community Groups/ Individuals Sector
Mr. John Ham
Recreation/Tourism Sector
Mr. Peter Hare
Community Groups/ Individuals Sector
Mr. Alf Jenkins
Recreation/Tourism Sector
Mr. Steve Klose
RAP Coordinator
Mr. Dennis Lang
Toronto Harbour Commission
Ms. Sheila Lambrinos
Environment/ Conservation Sector
Ms. Mary Lemyre
Community Groups/ Individuals Sector
Mr. Owen Lemyre
Community Groups/ Individuals Sector
Ms. Val Lennard
Business/Industry Sector
Ms. Peg Lush
Community Groups/ Individuals Sector
Mr. John Maher
Environment/ Conservation Sector
Ms. M. Kapur Malhotra
PAC Clerical Support
Mr. Jim Martin
PAC Facilitator
Mr. Luciano Martin
Municipal Sector
Ms. Sonya Meek
Metro Toronto and Region Conservation Authority
Counc. Bill Saundercook
Municipal Sector
Ms. Alex Semeniuk
Recreation/Tourism Sector
Mr. Robert Tonus
Environment/ Conservation Sector
Ms. Verda Young
Community Groups/ Individuals Sector

TECHNICAL ADVISORY COMMITTEE

Chair: Mr. Steven Klose
Ministry of the Environment

Mr. Wayne Bando
Town of Richmond Hill, Works Department
Mr. Dirk Blyleven
City of Mississauga, Planning and Building Department
Mr. Carlo Bonanni
City of Etobicoke, Planning Department
Mr. E.J. (Ted) Bowering
City of Toronto, Public Works and the Environment
Mr. Kim Choo-Ying
Borough of East York, Works Department
Mr. Joe D'Abramo
City of Toronto, Planning and Development Department
Mr. Ockie Fourie
Peel Region, Planning Department
Mr. David Gillies
City of North York, Works Department
Mr. Paul Higgins
City of Scarborough, Health Department
Mr. W.R. Hodgson
York Region, Engineering

Dr. Helen Jaczek
York Region,
Health Department
Ms. Barb Jeffrey
York Region,
Planning Department
Mr. Dalo Keliar
Town of Markham,
Engineering
Mr. Dennis Lang
Toronto Harbour
Commission
Mr. Owen Lemyre
PAC Representative
Mr. Michael Mansfield
City of Etobicoke,
Works Department
Ms. Sandra McKay
Ministry of the
Environment
Mr. John Marshall
City of Brampton,
Planning Department
Ms. Sonya Meek
Metro Toronto and Region
Conservation Authority
Mr. Neil Melman
City of York,
Parks and Recreation
Department
Mr. Ed Mickiewicz
Metro Toronto,
Planning Department
Mr. Winston Miller
City of York,
Health Department
Mr. John Minor
City of Scarborough,
Waste Water Management
Ms. Lynn Morrow
Metro Toronto,
Planning Department
Mr. William Munson
Metro Toronto,
Works Department

Mr. Chi Ng
City of York,
Engineering
Mr. Bela Nyitrai
Town of Vaughan,
Works Department
Mr. Robert Pickett
Metro Toronto,
Works Department
Mr. R.T. (Bob) Quinn
City of Scarborough,
Waste Water Management
Mr. Todd Salter
Town of Caledon,
Planning Department
Mr. John Sharpe
Durham Region,
Planning Department
Mr. Ralph Stanley
Peel Region,
Health Department
Mr. Peter Swinton
City of Scarborough,
Planning Department
Ms. Janice Teare
City of Mississauga,
Works Department
Mr. Greg Webster
City of Toronto,
Health Department
Mr. Hershel Weinberg
York Region,
Planning Department
Mr. King Wong
City of Etobicoke,
Health Department
Mr. Oryst Zyhar
York Region,
Health Department

SCIENTIFIC ADVISORY COMMITTEE

Mr. John Antoszek
Ministry of the
Environment
Dr. Hans Blokpoel
Environment Canada
Mr. Gary Bowen
Ministry of the
Environment
Mr. Ian Buchanan
Ministry of Natural
Resources
Mr. Michael D'Andrea
Ministry of the
Environment
Ms. Laurie Duncan
Environment Canada
Mr. Steve Griffiths
Ontario Hydro
Mr. Efriam Halfon
Canadian Centre for Inland
Waters
Mr. Al Hayton
Ministry of the
Environment
Mr. Dale Henry
Ministry of the
Environment
Mr. John Houweling
Ministry of Natural
Resources
Mr. Steven Klose
Ministry of the
Environment
Mr. Balbir Kohli
Ministry of the
Environment
Mr. Gord MacPherson
Metro Toronto and Region
Conservation Authority

Mr. Mohi Munawar
Canadian Centre for Inland
Waters
Mr. John Neate
Canadian Centre for Inland
Waters
Mr. Tim Rance
Ministry of Natural
Resources
Mr. Neville Reid
Ministry of the
Environment

The April 1990, Draft Discussion Paper on Remedial Options provided detailed information on a host of remedial options. A review of the Paper by the Technical and Public Advisory Committees subsequently identified a number of additional options to be considered. The aim of this appendix is to provide more information on the range of options that have been proposed to date. This list is not exhaustive. Detailed descriptions of the options can be found in the Draft Discussion Paper as well as the review documents produced by the Technical and Public Advisory Committees. All three documents are available from:

Metro Toronto and Region RAP Coordinator,
Ontario Ministry of the Environment,
4th floor, 7 Overlea Blvd.,
Toronto, Ontario
M4H 1A8
Tel/ 424-3000

Where available, costs have been identified (1988 dollars) and generally represent enhancement costs for existing programs.

1. Continue Enforcement of Laws and Development of Regulations.

• Continue Programs for Quality Control of Lakefill Material
$50K

• Finalize and Implement Provincial Lakefilling Policy
Not Costed

• Update Policy on Disposal of Dredged Material
Not Costed

• Stormwater Program (Policy, Guideline, Manual Development)
Not Costed

2. Improve Collection and Treatment of Sewage

• Eastern Beaches Detention Facilities
$10M

• Improve Sewage Treatment Plants:

Main	$1130M
Humber	$171M
Highland Creek	$135M
North Toronto	$50M

• Reduce and Virtually Eliminate Combined Sewer Overflows to Receiving Waters
$390M

3. Eliminate Illegal Storm Sewer Connections

• Trace and Disconnect Sanitary Connections to the Storm Sewers
$10M - $63M

• Trace and Disconnect Industrial Cross Connections
$200K per yr.

4. Reduce Inputs of Toxics from Households, Industries and Farms

• Utilize Municipal Sewer Use Bylaws to Reduce Contaminant Loading form Industry to the SewageTreatment Plants and Storm Sewers
$0.5M-$4.9M per yr.

• Improve Spills Response and Prevention
$100K

• Improve Industrial Best Management Practices (Pilot Project)
$150K

• Improve Household Hazardous Contaminants Programs
$700K per yr.

• Stricter Regulation of the Use of Pesticides and Education on the Proper Use of Fertilizers
Not Costed

5. Reduce Soil Erosion

• Improve Control of Sediment From Construction Activities
$200K per yr.

• Improve Erosion Control to Reduce Sediment Production
$0.5M-$1.0M per yr.

• Improve Agricultural Controls to Reduce Sediment Production
$1.1M-$4.3M per yr.

6. Reduce Amount of Stormwater Collected and the Amount of Contaminants in it

• Improved Catchbasin Cleaning
$0.2M-$2.1M per yr.

• Pet Control Bylaw Enforcement
Not Costed

• Long Range Strategy for Implementation of a Stormwater Quality Program
Estimated at Several $B

• Methods for Handling Contaminants at Snow Disposal Sites
Not Costed

• Create Wetlands
Not Costed

7. Reduce Rate at Which Stormwater is Discharged into Waterbodies

• Construct Multi-use Stormwater Ponds and Develop Design Criteria
$11M

8. Clean Up Contaminated Sediments

• Develop Strategy and Options to Deal with Contaminated Sediments, Options Include - Do Nothing, In-place Treatment, Removal and Disposal
Not Costed

9. Complete Research Which is Needed

• Complete Studies Initiated Through the RAP in Order to Complete the Information Base
Not Costed

• Complete Studies of Toxic Contaminant Sources
$260K

• Complete Fate and Transport Modelling Studies
$85K

• Toronto Waterfront Sediment Studies
$68K

• Conduct Study of Funding Mechanisms
Not Costed

• Long Term Fish Community Monitoring Along the Toronto Waterfront
$50K per yr.

• Monitoring of Airborne Toxic Chemical
$50K per yr.

• Investigate Problems Arising from Hazardous Waste Sites, Deep Well Disposal and Landfills
Not Costed

• Examine Methods to Reduce Use of Sodium Chloride and Other Chemicals used on Roads, and Possible Alternatives
Not Costed

• Establish Design Standards for Roads and Parking Areas to Maintain Hydrology with no Contamination
Not Costed

10. Improve Wildlife Habitat

• Tree, Shrub and Herbaceous Planting in Road Margins and Stream Bank Areas
Not Costed

• Encourage and Support Involvement of Public Interest Groups and the Private Sector to Conserve, Restore and Develop Fish Habitats
Not Costed

11. Improve Public Awareness about Water Issues

- Establish a Continuing RAP Communication Plan
$75K per yr.

- Establish a RAP Library to Encourage Public Research into Environmental Issues
$60K-$110K per yr.

- Establish a Foundation to Fund Local Initiative
$150K per yr.

- Continue Established Clean-up Programs Such as SCOUR
$100K per yr.

- Provide Assistance to Voluntary Programs Conducted by Non-Government Organizations
Not Costed

- Continue Government Stream Improvement Programs
$250K per yr.

- Encourage Public Awareness and Communication with Other RAPs
Not Costed

- Encourage Awareness and Participation in the Lake Ontario Toxics Management Plan
Not Costed

- Develop and Implement a Water Conservation Strategy
Not Costed